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NOAA Technical Report NMFS Circular 419

Marine Flora and Fauna of the Northeastern United States. Protozoa: Sarcodina: Amoebae

Eugene C. Bovee and Thomas K. Sawyer

January 1979

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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U.S. DEPARTMENT OF COMMERCE
Juanita M. Kreps, Secretary

National Oceanic and Atmospheric Administration
Richard A. Frank, Administrator
Terry L. Leitzell, Assistant Administrator for Fisheries

National Marine Fisheries Service

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FOREWORD

This issue of the "Circulars" is part of a subseries entitled "Marine Flora and Fauna of the Northeastern United States." This subseries will consist of original, illustrated, modern manuals on the identification, classification, and general biology of the estuarine and coastal marine plants and animals of the northeastern United States. Manuals will be published at irregular intervals on as many taxa of the region as there are specialists available to collaborate in their preparation.

The manuals are an outgrowth of the widely used "Keys to Marine Invertebrates of the Woods Hole Region," edited by R. I. Smith, published in 1964, and produced under the auspices of the Systematics-Ecology Program, Marine Biological Laboratory, Woods Hole, Mass. Instead of revising the "Woods Hole Keys," the staff of the Systematics-Ecology Program decided to expand the geographic coverage and bathymetric range and produce the keys in an entirely new set of expanded publications.

The "Marine Flora and Fauna of the Northeastern United States" is being prepared in collaboration with systematic specialists in the United States and abroad. Each manual will be based primarily on recent and ongoing revisionary systematic research and a fresh examination of the plants and animals. Each major taxon, treated in a separate manual, will include an introduction, illustrated glossary, uniform originally illustrated keys, annotated check list with information when available on distribution, habitat, life history, and related biology, references to the major literature of the group, and a systematic index.

These manuals are intended for use by biology students, biologists, biological oceanographers, informed laymen, and others wishing to identify coastal organisms for this region. In many instances the manuals will serve as a guide to additional information about the species or the group.

Geographic coverage of the "Marine Flora and Fauna of the Northeastern United States" is planned to include organisms from the headwaters of estuaries seaward to approximately the 200-m depth on the continental shelf from Maine to Virginia, but may vary somewhat with each major taxon and the interests of collaborators. Whenever possible representative specimens dealt with in the manuals will be deposited in reference collections of major museums.

After a sufficient number of manuals of related taxonomic groups have been published, the manuals will be revised, grouped, and issued as special volumes. These volumes will thus consist of compilations of individual manuals within phyla such as the Coelenterata, Arthropoda, and Mollusca, or of groups of phyla.

Marine Flora and Fauna of the Northeastern United States. Protozoa: Sarcodina: Amoebae

EUGENE C. BOVEE[1] and THOMAS K. SAWYER[2]

ABSTRACT

This manual contains a key to 15 families of freshwater and marine amoebae, of which only one, the Echinamoebidae, does not contain a known marine species. Diagnostic features for 19 genera, of which 14 include marine species, also are given. Descriptions and illustrations for 26 species of marine amoebae and an annotated systematic list are provided. The basic key is designed to assist the user in the identification of recognized species of marine amoebae that have been described from waters of the northeastern United States. However, certain well-known families and genera of freshwater forms are included to assist in their identification should they be discovered in seawater in future investigations. Information also is provided which includes comments on the general biology of the Amoebida, and techniques for microscopic observations and laboratory cultivation of many species. Most of the amoebae described in the key are free-living, but a few are parasitic and known to be of considerable economic importance. One new free-living species, *Vexillifera minutissima*, was discovered in Chincoteague Bay, Va., and is described herein for the first time.

INTRODUCTION

The amoebae are that group of Sarcodina (Protozoa) which move by means of subtle changes in the physical properties of their protoplasm. Probable gel-sol interconversions of their protoplasm produce extensions of the body mass to form pseudopods which are involved in both locomotion and feeding activities. The movement of the protoplasm may be cyclic in the body mass and in the pseudopods which conduct different specialized functions. The protoplasm is convertible from a slightly viscous fluid state (plasmasol) to a more viscous or rigid contractile jelly (plasmagel). The specific morphological appearance of various Sarcodina is a dynamic product of their protoplasmic activities and movements.

The amoebae of the ocean resemble those of freshwater ponds and streams, and the same group of characters can be used to distinguish them. The amoebae of the ocean are not yet well known. A great many unknown species remain to be found, described, identified and classified. However, enough of them are known to provide a basis for provisional identification to the generic level. Known species are included as examples.

Since identification of amoebae classically depends mainly on their forms and activities while in locomotion, observations must be made while they are active. Many marine amoebae are active at dawn or dusk, particularly the many small species found feeding on bacteria in bays and estuaries. Others are active mainly during midday. Observations at almost any time from dawn to dark, or even at night, may turn up an active amoeba.

Amoebae usually are difficult to preserve in their typical locomotive form. Sketches and photographs made by dependable taxonomists of amoebae are as yet the best sources for their identification, while fixed and stained specimens are useful for studying their nuclear structures. There are no extensive type collections, but a few protozoologists maintain certain species in continuous culture.

Photomicrographs are not an entirely adequate substitute for illustration of type specimens and descriptions should be supplemented with detailed sketches which are representative of the species being described; photomicrographs show only a planar section through the amoeba. Scanning electronmicrographs are not yet available for most amoebae and, besides being costly to prepare, have the disadvantage of portraying fixed specimens whose contours are more or less distorted. Hence, few amoebae have been illustrated with scanning techniques and those available do not substitute for direct microscopic identification.

Fixed and stained specimens may be prepared by using routine cytological methods for staining cells (Algar, 1966; Mitchell, 1966), including such stains as iron-hematoxylin, Kernechtrot, Feulgen's reaction, chromotrope 2R, or Heinrich's scarlet-fast-green. For electronmicroscopy and light microscopy, various modifications of combined osmic acid and glutaraldehyde fixations have been used with success.

DIAGNOSTIC CHARACTERS

Members of the Sarcodina, usually considered to be a subphylum of the Protozoa, are typically single celled; but some are multinucleate, and others are plasmodial; that is, they can fragment into uninucleate cytoplasmic parts which may fuse again into a multinucleate cyto-

[1]Department of Physiology and Cell Biology, Division of Biological Sciences, University of Kansas, Lawrence, KS 66045.
[2]Northeast Fisheries Center, NMFS, NOAA, Oxford, MD 21654.

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[2]Northeast Fisheries Center, NMFS, NOAA, Oxford, MD 21654.

plasmic mass. In most Sarcodina the nucleus is vesicular, i.e., round and bounded by its own membrane, and usually contains a round central endosome or nucleolus or both. The cytoplasm is motile within a mucoid outer coat (called a plasmalemma) and is extensible into lobes or threads, called pseudopods, which are also used in locomotive progress and feeding. The plasmalemma or outer coat may bear a fuzz-like layer which conforms to a glyco-calyx.

The amoebae are usually divided into two groups, based on whether the pseudopods are filose (i.e., long, slender, and needlelike) or lobose (fingerlike, or as lobes). Members of either group may have, or lack, a shell, depending on the species. Families and genera of amoebae which have no shell are distinguished by the dynamic form and movement of the body and the pseudopods during steady locomotion and the structure of the nucleus. Those which have shells are distinguished by both the active form of the pseudopods and the structure of the shell, as well as structure of the nucleus.

The Sarcodina, including the amoebae, are probably of several sources of evolutionary origin, i.e., are polyphyletic. Their principal similarity is in the formation of pseudopods. Any classification of them is artificial and is useful mainly for the distinction and identification of a particular genus or species. This key is therefore artificial and intended only for identification; it does not necessarily indicate phylogenetic relationships.

ECOLOGY

Most marine amoebae have been collected and observed from inshore areas, e.g., from intertidal zones, tide pools, brackish bays, or inlets. Some, e.g., *Vannella mira* and *Acanthamoeba polyphaga*, tolerate both fresh and seawater. Recent collections from the open ocean indicate, however, that some species are widely distributed throughout ocean waters in the bottom sediments or near the surface as pelagic organisms. Many marine amoebae are free living and feed mainly on bacteria. Others feed on algae. Some scavenge organic detritus. A few are carnivorous, eating other Protozoa or small Metazoa. Probably most species are widely distributed in the oceans owing to waves and ocean currents, but some have been found only in a few restricted locations. Temperature of the water, its salinity, and the availability of suitable food are perhaps the main factors in their distribution. Some are parasites of diatoms, fishes, molluscs, or arthropods, a few being pathogenic, the others commensal; such species are, of course, found with their hosts.

The importance of amoebae in the ocean has only recently begun to be assessed. The bacteria eaters and scavengers are important in maintaining the cleanliness of shallow, inshore waters and the surface waters of the open ocean. The pathogens—such as *Paramoeba perniciosa*, which parasitizes blue crabs, causing the grey crab disease—are important in oysters and other molluscs, but their effects on such hosts have not been well determined (Sawyer et al. 1970). In any event, amoebae are important organisms in oceanic ecosystems.

COLLECTING METHODS

Amoebae may be found in almost any damp place—moist soil or sand, on aquatic vegetation, on wet rocks, in lakes, ponds, streams, glacial meltwater, tide pools, bays, estuaries, on the bottom of or afloat in the open ocean, or on (or in) littoral organisms.

The easiest collecting method for shallow water species is to collect a sample of vegetation, with some soil or sand, and about a liter of water from around or near the plants. This, placed in a clean glass jar with a screw-cap lid, can be taken to the laboratory for observation.

In the open ocean, where amoebae may be few, 1 or more liters of water may be taken with a water sampler at any depth. This water should be passed through a fine filter. Vacuum filtration at 3 to 4 lbs/in^2, using millipore filters of 1.2 μm mesh and 47 mm diameter, is recommended. The filters can then be floated on unfiltered seawater (from the original sample) in 60 mm plastic dishes. Dishes may be kept at about 23°C ("room temperature") for several days or weeks. Transfers from the dishes to nutrient agar plates will often produce growth of bacteria and amoebae. Bottom samples may be taken with an Eckman or Petersen dredge.

Some amoebae are hardy in the laboratory; others are not. Cultures will usually produce only the hardier species. Nonetheless, clonal cultures are sometimes the best way to accurately distinguish one species from another closely similar species.

CULTURE

Many species that eat bacteria may be grown on a moist nutrient agar which will support bacterial growth. Seawater known to contain, or potentially containing, amoebae can be used as an overlay for a 1½% agar base or 1% agar plates can be used without a water overlay but must be kept in a moist chamber. These, when inoculated, will yield growth of some species. For brackish water organisms, brackish water should be used. *Aerobacter aerogenes* is a bacterium which many amoebae will eat. Amoebae which eat algae may be grown with the algae in a similar fashion.

Carnivorous amoebae should be cultured in clear (preferably filtered) seawater. Their prey should be grown separately and fed to them daily in amounts sufficient to support good growth, but without overfeeding.

Reference to methods successfully used by others in culturing amoebae is useful in setting up cultures (Sawyer 1975a, Page 1976).

OBSERVATIONAL TECHNIQUES

Most marine amoebae are so small that they require the use of a compound microscope to be seen. Some are so tiny or translucent as to be virtually invisible by bright-field microscopy. The best means of observing

them is with a phase-contrast microscope of good quality with 10×, 40×, and 100× objectives. Wide-field eyepieces of at least 10× magnifying power are very beneficial, and a binocular microscope is much easier and less tiring to use than a monocular one.

Amoebae tend to attach to and crawl on surfaces. They are most easily found in organic detritus on the bottom of a sample at the mud (sand) and water boundary. They may also be squeezed out of detritus or plant material more easily than they can be pipetted out of a sample. The squeezed material may be agitated with a glass needle after a drop of it has been placed on a clean microscope slide causing many amoebae to float out of the debris. These "floaters" eventually settle to the slide where they will resume a typical locomotive form. The edges of the coverslip placed over the drop should be sealed with petroleum jelly.

Observations should be made as soon as possible after the samples are collected. Some marine amoebae survive transfer to the laboratory for only a few minutes to a few hours after collection. Hardier species often may appear in large numbers after several days of culture, and others may appear and disappear at intervals for several weeks.

COMMON PROBLEMS IN DETERMINING THE IDENTITY OF MARINE SARCODINA

Most major taxa of marine Sarcodina are in need of reexamination with modern equipment such as phase contrast and electron microscopic techniques. Descriptions based on specimens grown in pure clonal culture also are highly desirable for species with several common morphological characteristics. We have attempted to compose a key to the Amoebida to include both morphological and ecological data, reinforced with appropriate literature citations, which should enable most investigators to recognize the principal genera and species of marine forms. Certain genera and species which so far have not been reported from marine habitats, or from waters of the United States, are included in the key to facilitate their identification should they be discovered by other workers. Since amoebae probably have received less comprehensive treatment than other groups of marine Protozoa, it would be shortsighted for us to assume that the present key includes most or all of the genera that are likely to be encountered in seawater samples. Rather, the marine amoebae so far discovered in waters of the northeastern United States possibly represent the "common" species which have little or no niche specificity.

Protozoa from aquatic habitats other than fresh water often are cited as being marine or brackish water species. Natural disasters such as floods or hurricanes may cause large intrusions of fresh water to dilute nearshore brackish or high salinity waters to the extent that their normal flora and fauna undergo shifts in species composition and abundance. Hurricane Agnes in the summer of 1972 had such a drastic effect on Chesapeake Bay, Md., that large species of Testacea and Heliozoa, ordinarily found in fresh water, were present in bloom proportions in the upper reaches of the bay. Historical records showed that the water usually ranged from 5 to 10‰ salinity but dropped to 2-3‰ after the hurricane. Thus, studies on brackish water protozoans in Chesapeake Bay yielded unusual findings in late 1972 and illustrate the importance of knowledge of environmental data before attempting to characterize the biota of a typical brackish water habitat. Some of the species of Testacea and Heliozoa encountered after the hurricane are illustrated herein as atypical Sarcodina in waters of the northeastern United States.

The increasing interest in marine Sarcodina may be noted in recent literature concerning their role in polluted and nonpolluted waters, in marine food webs, as parasites of marine hosts, and their suitability as models for study in molecular and cellular biology. Biologists who attempt to isolate and culture marine Sarcodina for study are likely to find genera and species that previously have not been reported from waters of the United States, including some which may belong to the Testacida, Foraminiferida, Proteomyxida, etc.—groups which are not included in the present key. Standard texts on the Protozoa are adequate for determining the appropriate class or order of most marine protozoans; however, there remains a major need for new keys to marine Sarcodina other than the Amoebida.

While the present key was in preparation an excellent key to freshwater amoebae was published by Page (1976) which included culture procedures and observational techniques. Page (1976) also provided several important references to recent publications on freshwater and soil amoebae, and includes a proposed reclassification of the subclass Gymnamoebia Haeckel, 1862. We accept the families Mayorellidae, Paramoebidae, and Cochliopodiidae as valid taxa while Page abolishes Mayorellidae and excludes Cochliopodiidae from the Amoebida. No attempt is made here to resolve or dispute existing problems in the taxonomy or systematics of the Amoebida. We have prepared the key to assist the user in determining the correct genera and species of marine amoebae with the idea that higher taxa be a matter of individual preference. A useful background on the taxonomy and systematics on the principal genera of amoebae may be obtained from the following publications, Greeff (1866, 1874), Chatton (1910), Volkonsky (1931), Singh (1952), Page (1967a, 1967b, 1968, 1969, 1972b, 1975, 1976), Bovee (1970), Singh and Das (1971), Bovee and Jahn (1973), Jahn et al. (1974), Sawyer and Griffin (1975).

GLOSSARY

acentriolar Lacking a centriole at the poles of the mitotic spindle during cell division.

algivorous Feeding on algae or diatoms.

amphosome A "secondary body" adjacent to the nucleus of amoebae in the family Paramoebidae Poche.

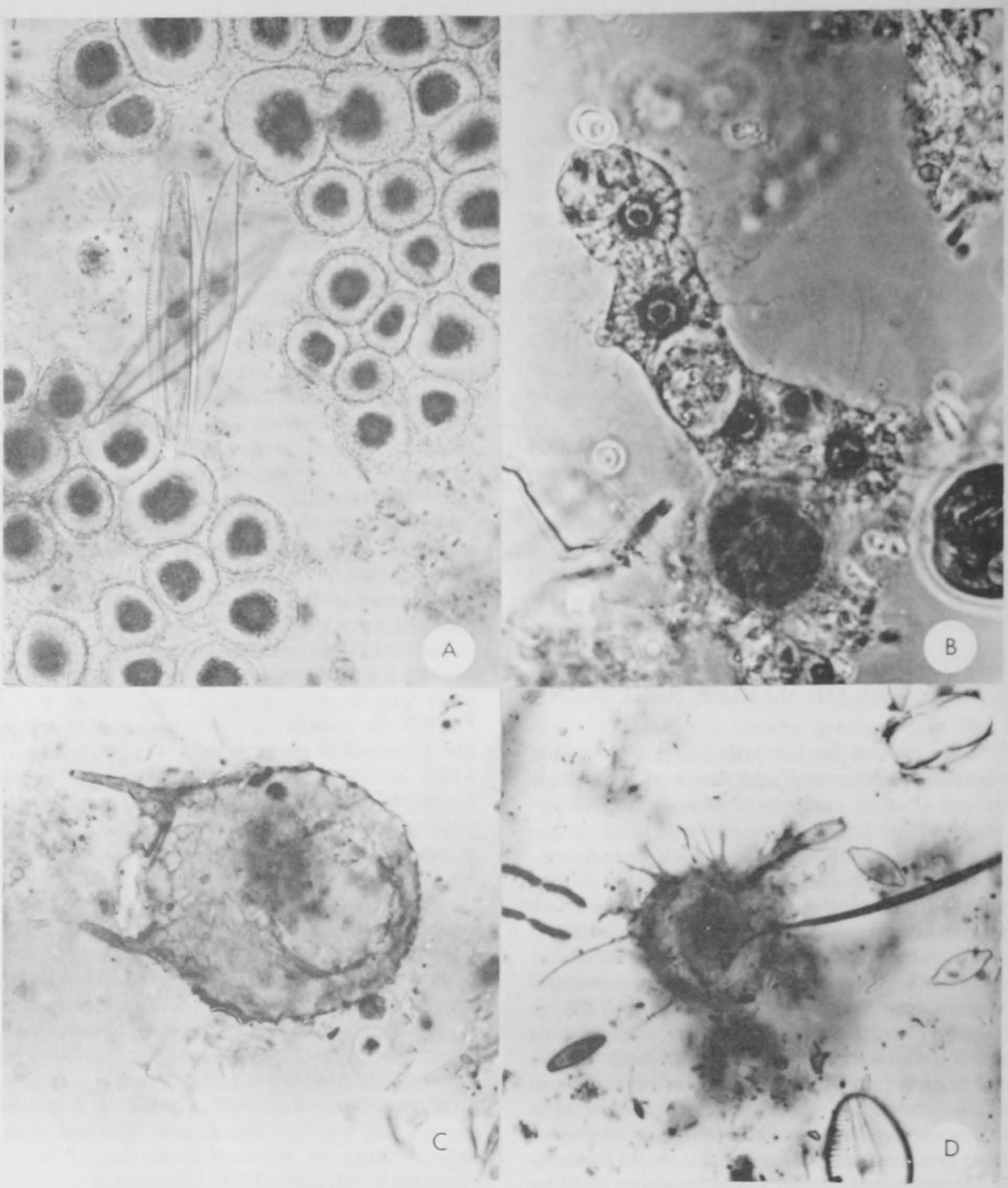


Figure 1.—Heliozoa and Testacea from upper Chesapeake Bay, Md., on protargol-stained cover slips, X560. A. *Acanthocystis* sp. B. *Actinophrys* sp. C. *Centropyxis* sp. D. *Difflugia* sp.

chromatin granules Small darkly staining granules usually displaced peripherally under the nuclear membrane.

chromatoid body Elongate refractile rod-shaped bodies which stain deeply with hematoxylin; often seen in cysts of *Entamoeba*.

clavate Club-shaped.

commensal An association in which an organism, the commensal, is benefited, while the host is neither harmed nor benefited.

cruciform Shaped like a cross.

cyst A stage in the life cycle of certain Protozoa in which a one- or more-layered membrane protects it during periods of inactivity; may resist dessication.

cytivorous Feeds on cells or tissues of other organisms.

dentate Having a toothlike form.

digitate Having a fingerlike form.

ectocyst The outer layer or membrane of a cyst.

ectoplasm The outer clear, nongranular protoplasm of an amoeba.

endocyst The inner layer or membrane of a cyst.

endoplasm the inner, granular protoplasm of an amoeba.

endosome The distinct inner mass of a nucleus of an amoeba, often called a nucleolus; may be spherical or fragmented.

filopod A slender thread- or needlelike pseudopod.

filose Like a needle or a thread.

flagellipod A slender, motile pseudopod which resembles, but is not, a flagellum.

flagellum A slender, fibrous, undulating or flexible organelle of a protozoan; used in swimming.

helical Coiled, as if around a cylinder.

hemolymph The internal fluids of an insect, crustacean, or other invertebrate metazoan.

herbivorous Feeds on plant materials.

light-refractile The ability of an object to bend light rays as they pass through it.

limaciform Shaped like a slug or snail's foot.

linguliform Shaped like a tongue.

lobopod A wide, rounded pseudopod; lobe-shaped.

lobose Like a lobe.

mesomitotic Type of nuclear division in which the nucleolus (endosome) dissolves as the spindle forms. The nuclear membrane disappears prior to telophase and centrioles are absent.

metamitotic Similar to mesomitosis but the nuclear membrane dissolves as the spindle forms. Centrioles or centriolelike bodies are formed.

morulate Shaped like a berry, a cluster of more or less globular parts.

multiform Having many forms.

nucleolus A compact mass of material within the nucleus of a cell.

omnivorous Feeds on a variety of plant or animal foods.

operculum A plug or cap which covers an opening through the membrane(s) of a cyst.

palmate Having the form of a hand and fingers.

papulate Having many small, rounded projections.

paranuclear Located beside the nucleus (the amphosome of *Paramoeba*, for example).

pathogen Any organism which causes a disease.

pelagic Floating in a moving current of water.

pharopod A flat, wide, clear, ectoplasmic pseudopod.

plasmalemma That part of the living ectoplasm which serves as a covering for the body of an amoeba.

polygonal Having many sides.

polymorphic Having more than one form.

promitotic A type of nuclear division in which the nucleolus (endosome) divides to form two polar caps, membrane is intact throughout nuclear division (as applied to amoebae).

pseudopod Any extension of cytoplasm which is used in locomotion or feeding.

punctate Marked with many points or dots, or having many points or depressions.

ramose Branching or having branches.

Sarcodina Those Protozoa which form pseudopods used in locomotion and feeding.

saprozoic Feeding by absorption of dissolved material.

scur A pseudopod shaped like a flake or a scale.

serrate Having form like a row of saw teeth.

shell An external covering of organic material with attached or imbedded mineral material.

secondary nucleus A questionable term for an amphosome or paranuclear body; adjacent to the nucleus of certain amoebae.

subspherical Oblate; not quite, but nearly spherical.

symbiont An association of two species of organisms that is mutually beneficial.

test An external, usually close fitting, covering of inorganic or organic material; usually with a small opening.

truncated Having the top or tip absent or removed.

uroid The posterior trailing protoplasm of an amoeba in active locomotion; bulbous, morulate, filose, filamentous, etc.

vesicle Any globular structure in the cytoplasm which is separated from the cytoplasm by a membrane; may contain fluid, food, minerals.

vesicular Like a vesicle.

water-expulsive vesicle That vesicle which collects water from the cytoplasm and expels it; also known as a pulsating vesicle or a contractile vacuole.

KEY TO FAMILIES, GENERA, AND SPECIES OF MARINE AMOEBAE

The diagnostic characters used in the couplets do not stand alone as singular distinctive features. Lobose, filose, or conical pseudopods may be common to more than one family or genus and are used in various combinations with other diagnostic features to provide a specific diagnosis. Thus, a primary character may be assigned to both members of a couplet when the members are closely related, and secondary characters are used to distinguish them from one another.

1 Body naked with pseudopods monopodial, polypodial, or transient and indefinite in number; lobose, conical, filose, or broad and variably discoid, ovoid, or ellipsoid. Uninucleate, or multinucleate with nuclear endosome entire or fragmented. Cysts present or absent, with or without operculae 2

1 Body naked with dorsal surface covered with microscopic granules produced via Golgi apparatus. Anterior and posterior margins smooth or with delicate thin pseudopods. Shape usually discoid or broadly ovate, little change in shape during locomotion . . . . . Cochliopodiidae . . . 45

1 Body naked, polymorphic in locomotion with pseudopods forked, branched, or plasmodial. Individual pseudopods blunt-tipped, lobose, or broadly tapered. Mononucleate or multinucleate . . . . . Stereomyxidae . . . 46

2 (*1*) Body in locomotion tubulate, limaciform, palmate, or clavate. Pseudopods few to many, lobose and more or less eruptive; clear or with clear hyaline caps. Posterior uroid temporary, semipermanent, or absent. Uninucleate, or multinucleate, with endosome entire or fragmented. Two to four flagella are transient in a few genera; cysts present or absent 3

2 (*1*) Body in locomotion triangulate, ovate, or ellipsoidal. Pseudopods one to many, conical, spiny, filose, or hemispherical and smooth with longitudinal ridges or temporary transverse ripples or waves. Uroid present or absent. Uninucleate, rarely binucleate, endosome entire or fragmented 18

3 (*2*) Body in locomotion tubulate or cylindroid with rounded lobose pseudopods, usually polypodial. Shape palmate to clavate in locomotion, pseudopods granular with clear hemispherical tips. Uroid temporary. Uninucleate with submembranal endosomal granules, or rarely multinucleate, or with central endosome. Flagella and cysts absent . . . . . Amoebidae . . . 4

3 (*2*) Body in locomotion more or less tubular, limaciform; pseudopods granular, more or less hemispherical and eruptive. Uroid semipermanent. Uninucleate, or multinucleate, with or without central endosome 8

4 (*3*) Pseudopods multiple, tubulate, rarely ridged; do not meld at bases during locomotion; one serves as main channel of protoplasmic flow. Usually uninucleate; nucleus discoid, without central endosome . . . . . *Amoeba lescherae*

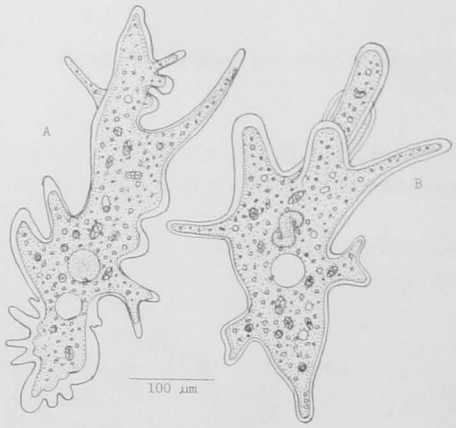


Figure 2.—*Amoeba lescherae*: A—locomotive, with uroid; B—locomotive, without uroid; after Taylor and Hayes (1944).

Amoeba lescherae

Size: Rounded, about 300μm diameter; polypodal in locomotion, 250 to 400 μm long, 200 to 300 μm wide; clavate in locomotion, 500 to 600 μm long, 100 to 150 μm wide. **Pseudopods**: Cylindroid, rarely ridged, slightly tapered with distinct, clear caps, tips. **Uroid**: Temporary, lobate. **Ectoplasm**: Clear 4 to 5μm thick over entire body; thicker at uroid and at pseudopodial caps. **Endoplasm**: Granular, cascades over pseudopodial tip during advance. **Nucleus**: Ellipsoid, sometimes twisted, 30 by 50 μm with granules adjacent to membrane, with a clear, oval or band-shaped endosomal mass. **Vesicles**: Few, small, 8 to 10 μm diameter; water-expulsive vesicle, when present, 40 to 50 μm diameter. **Crystals**: Square, prismatic, or deeply truncated bipyramids, 1.0 to 2.0 μm square. **Cyst**: Gelatinous, 30 μm diameter. **Feeding**: A scavenger, on detritus. **Habitat**: Marine, brackish tide pools. **Distribution**: Known from British Isles; probably widely distributed. **References**: Morphology; ecology; description; Taylor and Hayes (1944).

4 (*3*) Pseudopods few or multiple, cylindroid; one or more serve as main channel of protoplasmic flow. Uroid temporary or absent. Uninucleate or multinucleate, with or without central endosome 5

5 (*4*) Pseudopods multiple with conspicuous ridges or grooves in the ectoplasm; do not meld at bases. Endoplasm filled with bipyramidal crystals. Multinucleate, without central endosome. No marine species known . . . . . *Chaos*

5 (*4*) Pseudopods few, without ridges or grooves extending into ectoplasm; may or may not meld at bases. One or more pseudopods serve as main channel of protoplasmic flow. Uninucleate with or without central endosome 6

6 (*5*) One large pseudopod functions as main channel of protoplasmic flow. Granular endoplasm fills entire amoeba except for extreme tips of pseudopods; pseudopods do not meld at bases. Nucleus without central endosome. No marine species known . . . . . *Metachaos*

6 (*5*) One or more large pseudopods serve as main channel of protoplasmic flow; pseudopods may or may not meld at bases, without ridges or grooves. Uninucleate, with or without central endosome 7

7 (*6*) Pseudopods meld at bases, one or more serves as main channel of protoplasmic flow. Uninucleate without central endosome. No marine species known . . . . . *Polychaos*

7 (*6*) Pseudopods do not meld at bases, subcylindrical, not ridged. Mononucleate with central endosome. Parasites of coelenterates (*Hydra*). No marine species known . . . . . *Hydramoeba*

8 (*3*) Uroid semipermanent. Uninucleate or multinucleate, without central endosome. Often with bacterial symbionts or containing particles of organic matter . . . . . Pelomyxidae . . . 9

8 (*3*) Uroid more or less permanent, or absent. Uninucleate with central endosome. No apparent bacterial symbionts 10

9 (*8*) Large, multinucleate, nuclei without central endosome. Usually with bacterial symbionts . . . . . *Pelomyxa ostendensis*

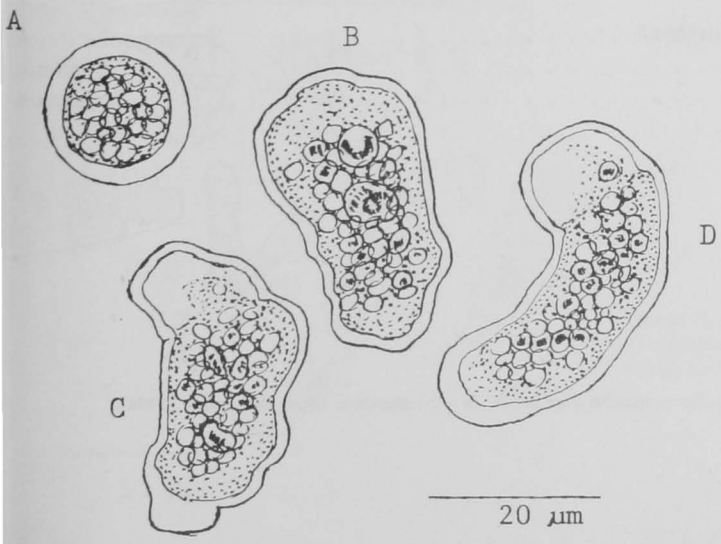


Figure 3.—***Pelomyxa ostendensis***: A—rounded, at rest; B—active, flattened; C, D—locomotive, "sausage" forms; after Kufferath (1952).

Pelomyxa ostendensis

Size: Rounded, 25 to 30 μm diameter; locomotive, like a truncated cone 35 to 40 μm long, 28 to 30 μm diameter anteriorly, 20 to 22 μm diameter at rear, or sausage-shaped 45 to 50 μm long, about 20 μm diameter anteriorly, about 15 μm diameter at rear. **Pseudopods**: Eruptive, clear hemispheres formed anteriolaterally, invaded and filled by granular endoplasm; no others formed. **Uroid**: Not described. **Ectoplasm**: Distinct, clear, about 2 μm thick over entire body. **Endoplasm**: Very granular. **Nucleus(i)**: Multinucleate, described as obscured by granules and food vesicles. **Vesicles**: Numerous, mainly food vesicles of various sizes to 10 μm or more diameter; no water-expulsive vesicle. **Cyst**: None known. **Feeding**: Herbivorous, on algae. **Habitat**: Marine; coastal tide pools. **Distribution**: Known from west coast of Europe, Atlantic Ocean, and North Sea, probably more widely distributed. **References**: Kufferath (1952).

9 (*8*) Large, uninucleate with central endosome; no apparent symbionts . . . . . *Trichamoeba schaefferi*

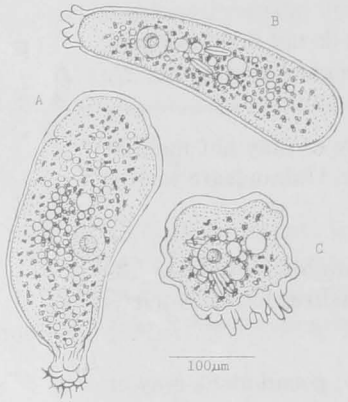


Figure 4.—*Trichamoeba schaefferi*: A, B—locomotive; C—at rest; after Radir (1927).

Trichamoeba schaefferi

Size: Subspherical, 150 to 175μm; polylobate, 175 to 250μm; clavate, 225 to 300μm. **Pseudopods**: Semi-eruptive lobes. **Uroid**: Semipermanent bulb or group of small lobes. **Ectoplasm**: Thin; distinct. **Endoplasm**: Clear; agranular. **Nucleus**: Spherical; 30 μm; with cup-shaped cluster of endosomal granules. **Water-expulsive vesicle**: None. **Food vesicles**: Rare. **Crystals**: As truncated pyramids in pairs with smaller ends apposed. **Cyst**: Unknown. **Feeding**: Herbivorous; eats diatoms. **Habitat**: Marine; in quiet bays and estuaries. **Distribution**: Known from Pacific coastal waters, United States, California, probably widely distributed. **References**: Morphology; description; Radir (1927).

10 (*8*) Body more or less clavate or variable. Uroid bristlelike or papulate, more or less permanent, or absent . . . . . Saccamoebidae . . . 11

10 (*8*) Body elongate and more or less cylindrical or flattened. More or less monopodial with clear eruptive pseudopods. Uroid filamentous or absent. Nuclear division mesomitotic or promitotic. Forms resistant cysts. Flagellate stage present or absent 12

11 (*10*) Body clavate, uroidal filaments bristlelike when present . . . . . .*Saccamoeba* . . . A
A (11) Uroid bristlelike . . . . . *S. gumia*
A (11) Uroid papulate . . . . . *S. fulvum*

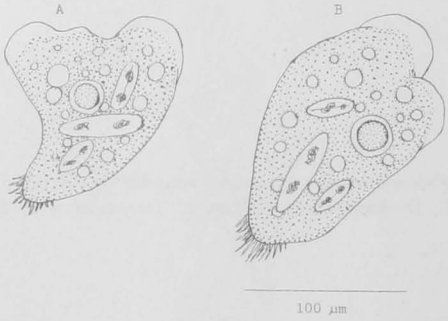


Figure 5.—*Saccamoeba gumia*: A, B—locomotive; after Schaeffer (1926).

Saccamoeba gumia

Size: Locomotive, 60 to 100μ m long; 30 to 40μ m wide. **Pseudopods**: Eruptive, at anterior end in locomotion. **Uroid**: Semipermanent, with bristlelike filaments to 10μ m long. **Ectoplasm**: Smooth; thin; clear. **Endoplasm**: Granular; fluid. **Nucleus**: Spherical; 12μ m diameter; with endosome, 7 to 10μ m diameter, central. **Water-expulsive vesicle**: None. **Other vesicles**: Few; clear; to 10μm diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous, on algae. **Habitat**: Marine; in tide pools. **Distribution**: Known from Atlantic coastal waters, United States. **References**: Morphology; ecology; description; Schaeffer (1926).

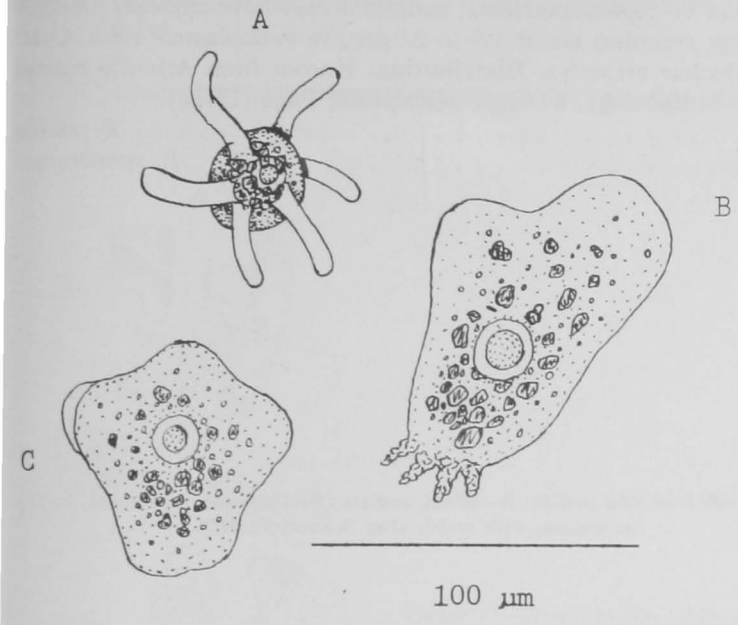


Figure 6.—*Saccamoeba fulvum*: A—afloat; B—locomotive; C—at rest; after Schaeffer (1926).

Saccamoeba fulvum

Size: Rounded, 40μm; **radiate**, body 20μm, pseudopods 20 to 30μm long; clavate, 50 to 70μm long by 25 to 30μm wide. **Pseudopods**: Locomotive, as short, blunt lobes; of radiate state, cylindroid with rounded ends. **Uroid**: Temporary, papulate. **Ectoplasm**: Smooth, clear. **Endoplasm**: Flocculently granular. **Nucleus**: Spherical, 9μm diameter; central endosome dense, 7μm diameter. **Water-expulsive vesicle**: None. **Crystals**: None. **Cyst**: Unknown. **Food vesicles**: 2 to 5μm diameter; contain brown granules. **Feeding**: Herbivorous, on diatoms. **Habitat**: Marine. **Distribution**: Known from Atlantic coastal waters, United States. **References**: Morphology; description; Schaeffer (1926).

11 (*10*) Body variable, triangulate or fan-shaped to clavate or subcylindrical. Uroidal filaments pronounced and more or less adhesive . . . . . *Rhizamoeba* . . . A
A (11) Uninucleate or multinucleate . . . . . *R. polyura*
A (11) Uninucleate . . . . . B

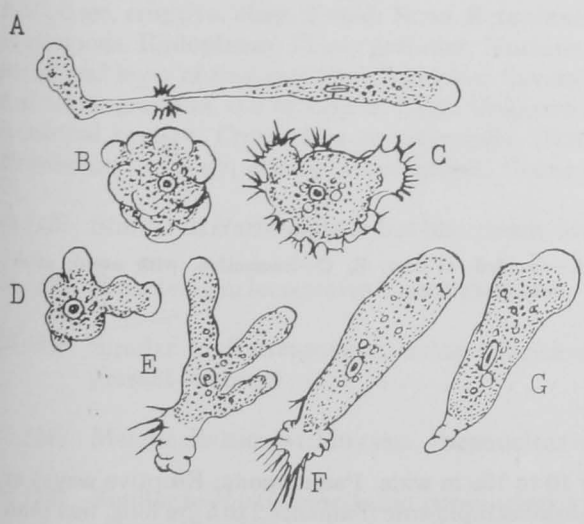


Figure 7.—*Rhizamoeba polyura*: A—biextended form; B—morulate, afloat; C—attached, contracted; D—beginning locomotion; E, F—locomotive, with uroid; G—locomotive, without uroid; after Page (1972a).

Rhizamoeba polyura

Size: Contracted, irregular 30 to 100 μm across; rounded, afloat, 22 to 43 μm diameter; locomotive, club-shaped, 25 to 135 μm long (mean, 75 μm), 20 to 30 μm broad near anterior end, tapered to 6 to 12 μm wide, at rear end. **Pseudopods**: Eruptive, granular, hemispherical, at anterior end, or at periphery of nonlocomotive state. **Uroid**: Temporary, clear, rounded, 6 to 12 μm with attached, stretched, tapered filaments 10 to 12 μm long. Similar filaments at periphery of contracted nonmotile stage. **Ectoplasm**: Clear, glossy, forms uroid and eruptive state of pseudopods. **Endoplasm**: Granular, fluid. **Nucleus**: Spherical, 5 to 6 μm diameter, with central endosome 2.5 to 3.5 μm diameter, both elastic, difficult to see; division acentriolar, mesomitotic; sometimes bi- to multinucleate; endosome may have adjacent granular mass. **Vesicles**: Few, small. **Crystals**: None; but many granules, about 1.0 to 2.0 μm, in endoplasmic rows. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow estuaries. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Maine. **References**: Morphology; ecology; description; Page (1972a).

B(A) Uninucleate, nucleus 10 μm in diameter . . . . . *R. pallida*

B(A) Uninucleate, nucleus 3.5 μm in diameter . . . . . *R. sphaerarum*

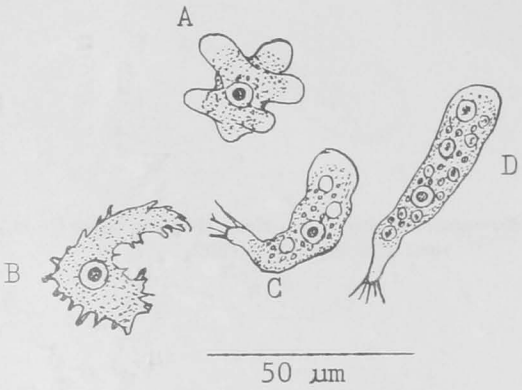


Figure 8.—*Rhizamoeba pallida*: A—afloat, radiate; B—flattened, contracted; C, D—locomotive, with uroid; after Schaeffer (1926).

Rhizamoeba pallida

Size: Rounded, about 30 μm; locomotive, clavate, 50 to 60 μm long by 25 to 30 μm wide. **Pseudopods**: Slowly eruptive, at anterior end in locomotion. **Uroid**: Always present in locomotion, as several fine, ectoplasmic filaments 3 to 12 μm long. **Ectoplasm**: Thin, clear, as thin anterior cap and as uroidal bulb and filaments. **Endoplasm**: Finely granular, with a few granules 1 to 2 μm. **Nucleus**: Spherical, 10 μm, with distinct central endosome, 5 μm. **Vesicles**: Several food vesicles 3 to 8 μm diameter; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Gulf of Mexico and Atlantic coastal waters, United States. **References**: Morphology; ecology; description; Schaeffer (1926).

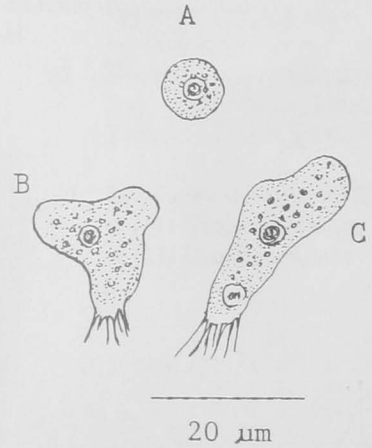


Figure 9.—*Rhizamoeba sphaerarum*: A—rounded, at rest; B, C—locomotive, with uroid; after Schaeffer (1926).

Rhizamoeba sphaerarum

Size: 8 to 11 μm diameter; locomotive, clavate, 20 to 30 μm long by 10 to 15 μm wide. **Pseudopods**: Eruptive waves at anterior margin. **Uroid**: Nearly always present in locomotion, of posterior ectoplasmic filaments 2 to 5 μm long, less than 0.5 μm diameter. **Ectoplasm**: Clear, glossy, thin. **Endoplasm**: Clear, finely granular; about 50 to 100 other granules, about 0.5 to 1.0 μm diameter. **Nucleus**: Spherical, 3.5 μm diameter; endosome indistinct. **Vesicles**: Several food

vesicles, 1.0 to 4.5μm; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous, eats small algae, bacteria. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Gulf of Mexico and Atlantic coastal waters, United States. **References**: Morphology; ecology; description; Schaeffer (1926).

12 (*10*) Nuclear division mesomitotic; paranuclear amphosome present or absent. Flagellate stage absent. Cysts without operculae . . . . . Hartmannellidae . . . 13

12 (*10*) Nuclear division promitotic. Flagellate stage present or absent. Ectocysts with or without operculae . . . . . Vahlkampfiidae . . . 16

13 (*12*) Nuclear division mesomitotic, paranuclear amphosome absent; uninucleate. Cysts smooth . . *Hartmannella*

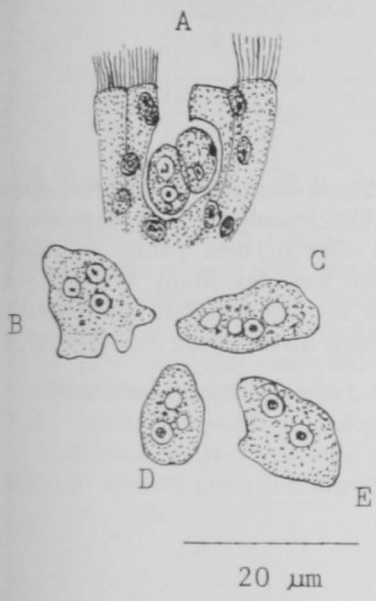


Figure 10.—*Hartmannella tahitiensis*: A—two amoebae in the intestinal epithelium of an oyster; B-E—active amoebae, stained; after Cheng (1970).

Hartmannella tahitiensis

Size: Rounded 6 to 10μm; locomotion, clavate to triangulate, 8 to 13μm long by 4 to 10μm wide. **Pseudopods**: More or less lobose, eruptive, clear. **Uroid**: None. **Ectoplasm**: Clear, as anterior one-fourth to one-third of locomotive body and pseudopods. **Endoplasm**: Finely granular. **Nucleus**: Spherical, 2.0μm, with endosome 0.8 to 1.0μm (with or without a peripheral layer of fine granules). **Vesicles**: Several, with food, 1.5 to 3μm diameter. **Crystals**: None; but several endoplasmic granules, 0.5 to 1.0μm. **Cyst**: Unknown. **Feeding**: Bactivorous; cytivorous. **Habitat**: Reported from gut of moribund oysters, *Crassostrea commercialis*. **Distribution**: Reported from Tahiti; perhaps worldwide. **References**: Morphology; ecology; etiology; description; Cheng (1970).

13 (*12*) Similar to *Hartmannella* but binucleate. Meiosis present or absent in cysts 14

14 (*13*) Binucleate in locomotive form and cyst. No meiosis within cysts. No marine species known . . *Hartmannina*

14 (*13*) Similar to *Hartmannina*, meiotic division within cysts, or absent. Paranuclear amphosome present or absent 15

15 (*14*) Meiotic division within cysts. Paranuclear amphosome absent. No marine species known . . . . . *Glaeseria*

15 (*14*) Similar to *Hartmannella* but paranuclear amphosome present. No meiotic divisions, cysts unknown. Parasitic in chaetognath worms (*Sagitta* sp.) . . . . . *Janickina* . . . A
A(15) Endoplasm strongly granular, many vesicles posteriorly . . . . . *J. pigmentifera*
A(15) Endoplasm with few granules, vesicles few and dispersed . . . . . *J. chaetognathi*

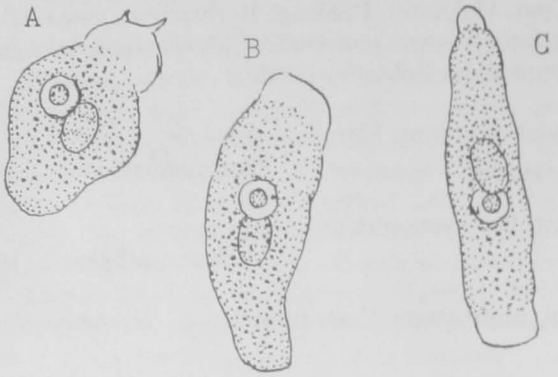


Figure 11.—*Janickina pigmentifera*: A—feeding; B, C—locomotive; after Janicki (1912).

Janickina pigmentifera

Size: Locomotive, 25 to 50µm long when clavate, average length 34µm; radiate, body 25µm diameter; with pseudopods, to 50µm diameter. **Pseudopods**: Locomotive, more or less eruptive lobes; radiate, stubby, rounded. **Uroid**: Temporary. **Ectoplasm**: Thin, clear. **Endoplasm**: Strongly granular. **Nucleus**: 15 by 18µm, with adjacent, oval, paranuclear body (amphosome), 9 by 11µm, divides synchronously with nucleus; nuclear division, mitotic. **Vesicles**: Many, at rear. **Cyst**: Unknown. **Feeding**: Commensal, saprozoic. **Habitat**: Testicle; marine chaetognath worms (*Sagitta*). **Distribution**: With hosts in Atlantic Ocean and Mediterranean Sea. **References**: Morphology; ecology; distribution; Janicki (1912).

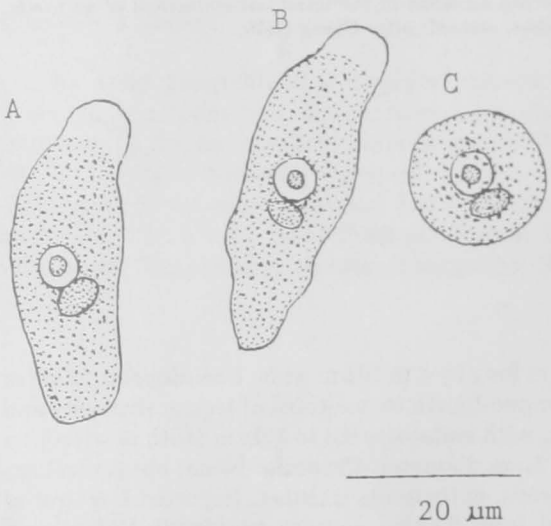


Figure 12.—*Janickina chaetognathi*: A, B—locomotive; C—rounded, at rest; after Janicki (1912).

Janickina chaetognathi

Size: Locomotive, 25 to 30µm long, average 27µm; rounded, 20µm average diameter. **Pseudopods**: Locomotive, more or less eruptive lobes. **Uroid**: Temporary, when present. **Ectoplasm**: Clear, as thin plasmalemma and eruptive pseudopods. **Endoplasm**: Granular. **Nucleus**: Subcylindroid, 13 by 11µm, lacks endosome; with indistinct, elliptical, adjacent, paranuclear body (amphosome), 9 by 7µm, divides synchronously with nucleus; nuclear division, mitotic. **Vesicles**: Few, refractile, dispersed. **Cyst**: Unknown. **Feeding**: Commensal, saprozoic. **Habitat**: Testicle; marine chaetognath worms (*Sagitta*). **Distribution**: With host in Atlantic Ocean and Mediterranean Sea. **References**: Morphology; ecology; distribution; division; Janicki (1912).

16 (*12*) Pseudopods eruptive and explosive, locomotion rapid. Ectocyst smooth or rippled. Flagellate stage absent . . . . . *Vahlkampfia* . . . A
A(16) Uroidal filaments weak to absent . . . . . *V. baltica*
A(16) Uroidal filaments in multiples . . . . . B

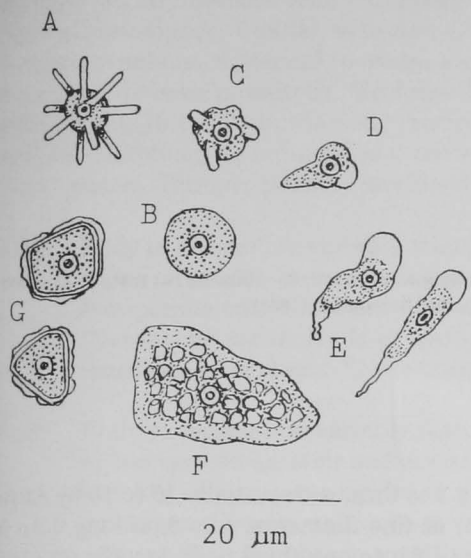


Figure 13.—*Vahlkampfia baltica*: A—radiate, afloat; B—rounded, at rest; C, D—beginning locomotion; E—two locomotive amoebae, with uroid; F—flattened well-fed forms; G—two cysts; after Schmöller (1961).

Vahlkampfia baltica

Size: Rounded, 8 to 9.5 μ m diameter; locomotive, monopodial, 17 to 20μm long by 4 to 5μm wide. **Pseudopods**: Eruptive from anterior margin with thin barely recognizable hyaline border. **Uroid**: Absent. **Ectoplasm**: Clear, as thin plasmalemma and indistinct cap around pseudopods. **Endoplasm**: Finely granular and pale. **Nucleus**: Spherical, about 2.5 to 3 μm, distinct with spherical endosome. **Vesicles**: Few, containing bacteria; distinct water-expulsion vacuole. **Crystals**: None. **Cyst**: Irregular shape with thin double wall, and 3, 4, or 5 shallow points; not typical of the genus *Vahlkampfia*. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from European Atlantic waters. **References**: Morphology; ecology; description; Schmöller (1961).

B(A) Filaments clear and slender, 5-15μm long . . . . . *V. salina*
B(A) Filaments clear and small, 1-3μm . . . . . *V. longicauda*

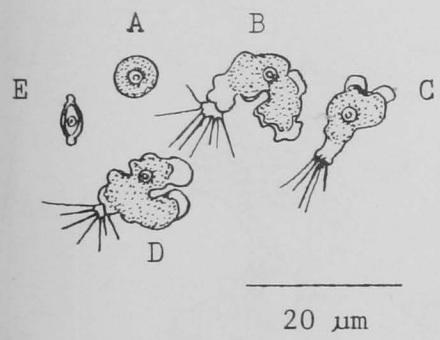


Figure 14.—*Vahlkampfia salina*: A—rounded, at rest; B-D—locomotive, with uroid; E—cyst; after Hamburger (1905).

Vahlkampfia salina

Size: Rounded, 6 to 8μm; locomotive, more or less clavate, 8 to 12μm long by 6 to 8μm wide, with uroid to 25μm long. **Pseudopods**: Eruptive, clear, hemispherical at advancing margin or periphery. **Uroid**: Several slender, clear filaments, 5 to 15μm long, tapered from a base about 0.6μm diameter to barely visible tips, originating from a clear, posterior bulb about 3μm diameter; uroid usually present. **Ectoplasm**: Thin, clear, except as pseudopods. **Uroid**: Uroidal bulb and filaments present. **Endoplasm**: Finely granular. **Nucleus**: Spherical, about 2.5μm diameter, indistinct, with central endosome about 1.0μm diameter, also indistinct unless stained. **Vesicles**: Few, containing bacteria; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Smooth, spindle-shaped with terminal knobs, 6 by 4μm with visible nucleus, one or two vesicles, few granules; bilaminar, terminal knobs part of ectocyst; endocyst spindle-shaped. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters, tidal pools. **Distribution**: Probably worldwide; known from Mediterranean and Atlantic coastal waters of Europe and Atlantic coastal waters of United States. **References**: Description; Hamburger (1905).

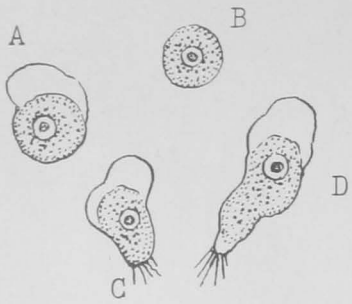


Figure 15.—*Vahlkampfia longicauda*: **A—beginning locomotion; B—rounded, at rest; C, D—locomotive, with uroid; after Schmöller (1964).**

10 μm

Vahlkampfia longicauda

Size: Rounded, 5 to 11μ m diameter; locomotive, clavate, 7.5 to 20μm long by 3 to 6μm wide, usually 10 to 15 by 4μm. **Pseudopods**: Clear, eruptive, from anterior margin. **Uroid**: Usually present, as fine filaments, 1 to 3μm long, 0.3μm diameter, barely visible. **Ectoplasm**: Thin, clear, as anterior clear zone, one-fifth to one-third body length, eruptive pseudopods and uroidal filaments. **Endoplasm**: Finely granular. **Nucleus**: Spherical, about 1.0μ m diameter, with distinct endosome, 0.6μm diameter. **Vesicles**: Small, seldom present, 1.0 to 2.0μm diameter; no water-expulsive vesicle. **Crystals**: Absent. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Atlantic coastal waters of Europe and United States. **References**: Morphology; ecology; description; Schmöller (1964).

16 (*12*) Similar to *Vahlkampfia* but with a temporary amoeboflagellate stage 17

17 (*16*) Two flagella in flagellate stage, cysts smooth with operculae. No marine species known . . . . . .*Naegleria*

17 (*16*) Similar to *Naegleria*, 4 flagella in flagellate stage. Amoeboflagellates of two different sizes. Cysts without operculae . . . . . .*Heteramoeba clara*

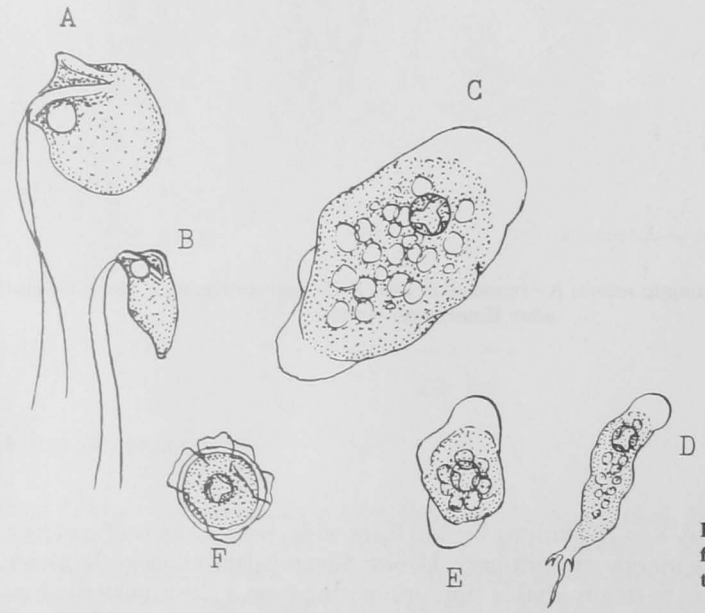


Figure 16.—*Heteramoeba clara*: **A—large flagellated form; B—small flagellated form; C—large ameboid form; D—small, actively locomotive form; E—feeding form; F—cyst; after Droop (1962).**

50 μm

Heteramoeba clara

Size: Flagellate stage, rounded, 20 to 30μm, with collar and gullet, 2 flagella, each about 60μm long. Ameboid, rounded, 12 to 40μm; locomotive, more or less elongated, clavate, 20 to 70μm long by 10 to 30μm wide. **Pseudopods**: Clear, more or less eruptive bulges from anterior margin in locomotion. **Uroid**: Often present as several clear filaments, 5 to 10μm

long from slightly bulbous rear end. **Ectoplasm**: Thin, clear, as anterior one-fifth to one-fourth of locomotive body and eruptive pseudopods, uroidal bulb and filaments. **Endoplasm**: Clear, granular, many refractile granules 3 to 5 μm diameter. **Nucleus**: Spherical to ovate, about 7 μm diameter; no endosome; chromatin in patches adjacent to nuclear membrane; division promitotic. **Vesicles**: Many, as light-refractile bodies; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Round, 10 to 20 μm diameter; endocyst round, smooth, thick, no operculae; ectocyst, thin wrinkled, often torn. **Feeding**: Herbivorous; on algae and bacteria. **Habitat**: Marine; shallow waters. **Distribution**: Known from Atlantic coastal waters, Europe; possibly worldwide. **References**: Morphology; growth; division; description; Droop (1962).

18 (*2*) Body in locomotion variably triangulate or ovoid. Pseudopods few to many, conical or filose and spiny; originate from advancing margin, body surfaces, or both. Posterior uroid temporary, semipermanent, or absent. Mononucleate, rarely multinucleate, endosome round and distinct. Division by mesomitosis or metamitosis. Paranuclear body ("Nebenkörper") adjacent to nucleus, present or absent. Single transient flagellum present in one family. Cysts present or absent 19

18 (*2*) Body in locomotion variably discoid, ovoid, triangulate, or trapezoidal. Monopodial with more or less smooth anterior and posterior margins. Dorsal surface smooth or with longitudinal ridges or folds, or transverse ripples or waves of clear protoplasm. Uroidal filaments few and delicate, or absent. Usually uninucleate with spherical or fragmented endosome. Division mesomitotic with nuclear membrane sometimes persisting until late anaphase. No flagellate stage. Cysts usually absent 36

19 (*18*) Pseudopods clear, conical, pointed, with more or less blunt tips; usually long and slender on body surface, broad based and short on clear advancing margin. Nucleus vesicular with spherical endosome, and adjacent, dense, paranuclear body. Free living or parasitic in decapods. Cysts and flagellates absent . . . . . Paramoebidae . . . 20

19 (*18*) Pseudopods clear, elongate and conical, or short and spiny. Nucleus spherical with distinct endosome; dense paranuclear body absent. Cysts present or absent. Flagellate stage in one family 21

20 (*19*) With characters of the family, free living . . . . . .A
A(20) Large (70 to 90 μm); feeds on diatoms . . . . . *Paramoeba eilhardi*
A(20) Small (10 to 40 μm); bactivorous . . . . . .B

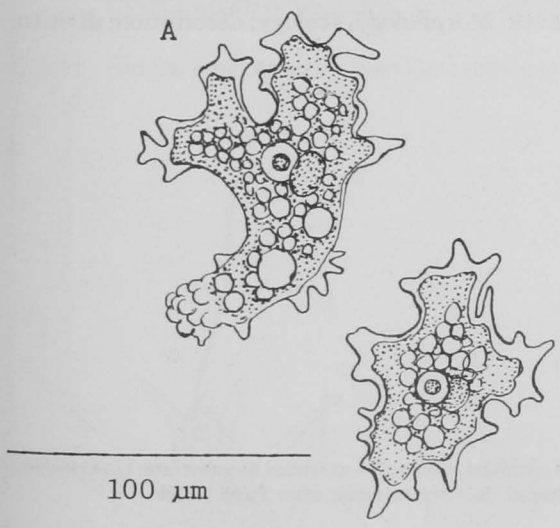


Figure 17.—*Paramoeba eilhardi*: A, B—locomotive forms; after Grell (1961).

Paramoeba eilhardi

Size: Rounded, 40 to 50 μm diameter; locomotive, 70 to 90 μm long by 50 to 65 μm wide, temporarily to 100 μm long by 20 to 30 μm wide. **Pseudopods**: From advancing clear margin, usually in pairs, 5 to 10 μm long, 3 to 5 μm basal diameter tapered to tips 2 μm diameter. **Uroid**: Temporary, if present. **Ectoplasm**: Clear, distinct at anterior margin. **Endoplasm**: Vesicular and granular. **Nucleus**: Spherical, 6 to 7 μm, with central endosome, 4 μm diameter; with one to three secondary, dense, ovoid paranuclear units, 8 by 4 μm, possibly parasites adjacent to true nucleus. **Vesicles**: Many, 2 to 4 μm diameter; no water-expulsive vesicle. **Cyst**: Reported as mucilaginous. **Feeding**: Herbivorous, on algae.

Habitat: Marine; in coastal waters. **Distribution**: Known from European Atlantic coast, and Atlantic coast of the United States. **References**: Morphology; description; ecology; division; Schaudinn (1896), Grell (1961).

B(A) Small (20 to 40μm); resembles *Mayorella* . . . . . *P. pemaquidensis*

B(A) Smaller than *P. pemaquidensis* (10 to 20μm); resembles a duck's foot . . . . . *P. aesturina*

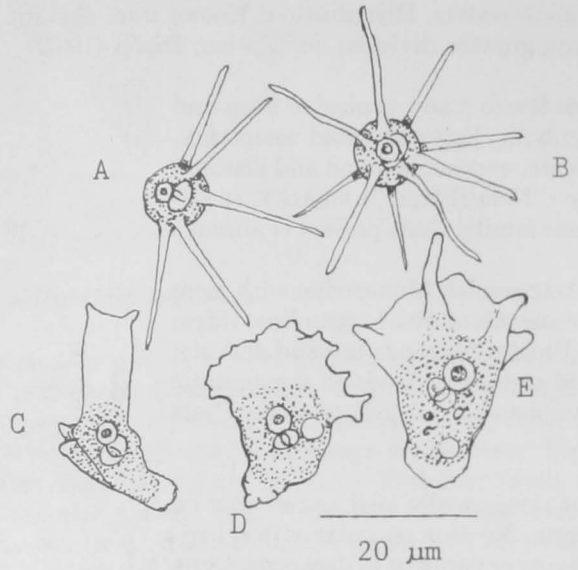


Figure 18.—*Paramoeba pemaquidensis*: A, B—radiate, afloat; C—beginning locomotion; D, E—actively locomotive; after Page (1970b).

Paramoeba pemaquidensis

Size: Contracted, irregular, about 10 μ m across; afloat, irregular 7 to 10 μ m; radiate, body mass 8.5 μ m diameter, with pseudopods to 60μm across; locomotive, 14 to 37.5μm long (mean, 21μm) by 12 to 48μm across, usually longer than broad. **Pseudopods**: Of radiate stage, 25 to 30μm long, usually straight, sometimes twisted, tapered, 3.0μm basal diameter to 2.0μm diameter at rounded tips; locomotive stage, from clear, anterior margin, bluntly conical, 3 to 6μm long. **Uroid**: Temporary, morulate, of old pseudopods. **Ectoplasm**: Clear, forms anterior margin and pseudopods. **Endoplasm**: Clear, granular. **Nucleus**: Spherical, 3.5 to 5μm, with central endosome 2.0 to 2.5μm diameter; division, mesomitotic; with attached, paranuclear structure 2.5 to 3.5 μ m. **Vesicles**: Several, 2 to 3 μ m, contain bacteria. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Waters of sandy beaches; marine. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Maine. **References**: Morphology; ecology; description; division; Page (1970b).

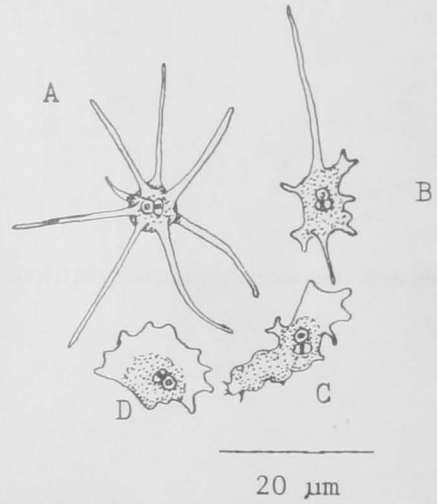


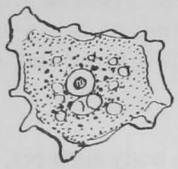
Figure 19.—*Paramoeba aesturina*: A—radiate, afloat; B—extended on substrate; C—extended, active form; D—fan-shaped, locomotive form; after Page (1970b).

Paramoeba aesturina

Size: Rounded, 8 to 10 μ m across; afloat, irregular 10 to 12 μ m across or radiate, body mass 7 to 8μm diameter, with pseudopods to 60μm across; locomotive, 10 to 20μm long by 7 to 14μm wide, mean length about 13.5μm. **Pseudopods**: Of radiate stage, 20 to 25μm long, tapered, about 1.5μm basal diameter to about 1.0μm at tips; of locomotive stage, 1.5

to 3.5μm long, bluntly conical 1.5 to 2.0μm wide, from anterior clear margin. **Uroid**: Temporary, bulbous or morulate, of old retracted pseudopods. **Ectoplasm**: Clear, forms distinct anterior border and pseudopods. **Endoplasm**: Granular, clear. **Nucleus**: Spherical, 2.5 to 3μm, with central endosome 1.0 to 1.5μm diameter; division, mesomitotic; has attached, dense, secondary paranuclear structure 1.5 to 2.5μm. **Vesicles**: Few, small. **Crystals**: None. **Cyst**: None. **Feeding**: Bactivorous. **Habitat**: Marine; coastal salt marshes. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Maine. **References**: Morphology; ecology; division; description; Page (1970b).

20 (*19*) With characters of the family, parasitic . . . . . *Paramoeba perniciosa*



20 µm

Figure 20.—*Paramoeba perniciosa*: after Sprague et al. (1969).

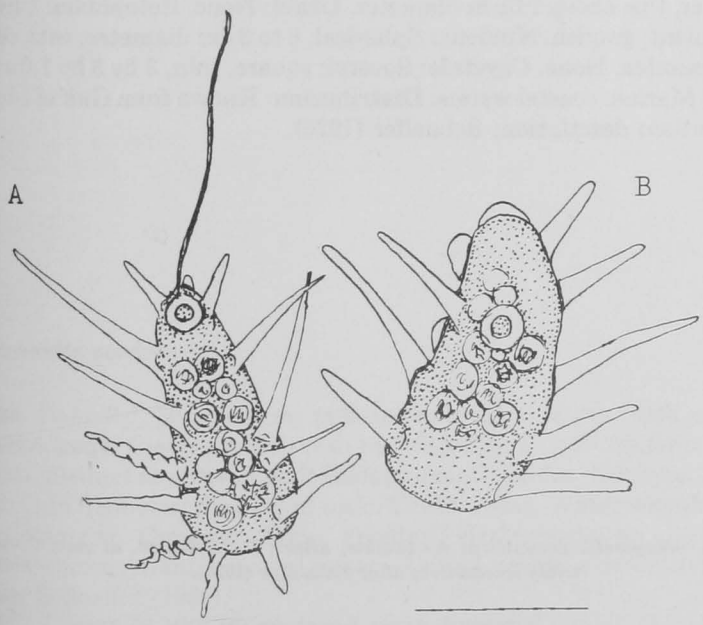
Paramoeba perniciosa

Size: Rounded 15 to 20μm; locomotive, 40 to 50μm long by 30 to 50μm wide. **Pseudopods**: Few, one to three at anterior margin as clear, blunt, conical or tonguelike lobes of clear ectoplasm, 3 to 5μm long. **Uroid**: None. **Ectoplasm**: Clear. **Endoplasm**: Vesicular and granular. **Nucleus**: Spherical, 3μm diameter with central endosome 1.75μm diameter; also with ovoid, dense, secondary paranuclear unit, 3 by 1.5μm, possibly parasitic, adjacent to true nucleus. **Vesicles**: Many, 1.5 to 3μm diameter; no water-expulsive vesicle. **Cyst**: Unknown. **Feeding**: Parasitic; perhaps cytivorous. **Habitat**: Hemolymph of blue crab, *Callinectes sapidus*; marine coastal waters, Atlantic coast, United States. **Distribution**: Known from Virginia and Maryland, probably more widely distributed. **References**: Parasitism; Sprague and Beckett (1966); physiology; pathogenicity; Sawyer (1969); taxonomy; description; distribution; Sprague et al. (1969).

21 (*19*) Pseudopods clear and conical, more or less broad based and short to elongate; rigid or waving. Monoflagellate stage present or absent. Do not form cysts 22

21 (*19*) Pseudopods numerous, short and spiny; originate from advancing margin, body surface, or both. Cysts smooth or wrinkled, with or without operculae. No flagellate stage 32

22 (*21*) Single, long, anterior flagellum present . . . . . Mastigamoebidae



50 µm

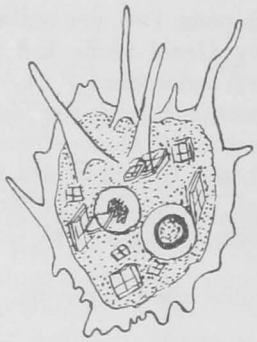
Figure 21.—*Mastigamoeba aspera*: A—ameboid form with flagellum; B—ameboid form without flagellum; after Page (1970a).

Mastigamoeba aspera

Size: Rounded, 45 to 50 μm; locomotive, 75 to 150 μm long; clavate, broadest near the rear, 30 to 50 μm, narrow near anterior end, 20 to 30 μm. **Pseudopods**: Many, formed at anterior end, clear, conical, round-tipped, extend to 20 to 25 μm long, 3 μm at base tapered to pointed tips, moved along body basally to rear; absorbed. Often with many attached bacteria along pseudopodial lengths. Also, usually, one flagellum present, 20 to 25 μm long. **Uroid**: Temporary, of retracting pseudopods at rear. **Ectoplasm**: Clear; as rounded anterior end and pseudopods. **Endoplasm**: Clear; granular. **Nucleus**: Spherical, 10 to 15 μm, with central endosome 8 to 10 μm diameter. **Vesicles**: Many food vesicles, 5 to 20 μm diameter; many chromatophores of prey in small vesicles; water-expulsive vesicle 16 to 22 μm in fresh water; absent in seawater. **Crystals**: None, when amoeba in seawater. **Cyst**: Unknown. **Feeding**: Herbivorous; eats algae. **Habitat**: Freshwater or marine; in shallow pools. **Distribution**: Known from estuarine tide pools, Atlantic coast, United States (Maine); probably cosmopolitan. **References**: Description; Schulze (1875); marine; ecology; Page (1970a).

22 (*21*) Flagellate stage absent . . . . . Mayorellidae . . . 23

23 (22) With characters of the family. Elongate rigid pseudopods from body surfaces, do not swing in an arc. Pseudopods of radiate stage stellate, more or less rigid . . . . . *Mayorella* . . . A
A(23) Length less than 100 μm, crystals present . . . . . B
A(23) Length 30-170 μm, crystals absent C
B(A) Length 25-30 μm, crystals few . . . . . *M. crystallus*
B(A) Length 40-50 μm, crystals numerous . . . . . *M. gemmifera*

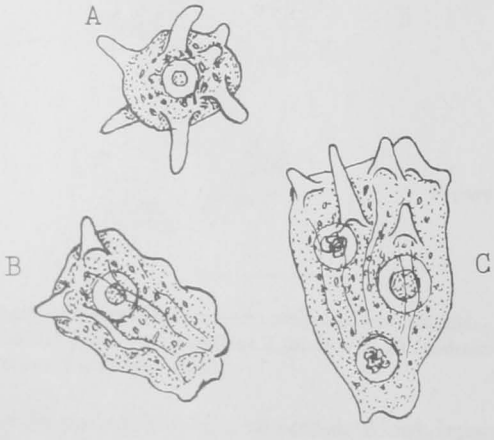


25 μm

Figure 22.—*Mayorella crystallus*: after Schaeffer (1926).

Mayorella crystallus

Size: Locomotive, 25 to 30 μm long. **Pseudopods**: From clear anterior end and body surface; clear, slightly tapered with rounded ends; 2 to 10 μm long, 2 to 3 μm basal diameter, tips about 1.0 μm diameter. **Uroid**: None. **Ectoplasm**: Clear, thin; distinct at advancing margin. **Endoplasm**: Flocculent; grayish. **Nucleus**: Spherical, 6 to 8 μm diameter; with central endosome, 3 to 4 μm diameter. **Vesicles**: None. **Granules**: None. **Crystals**: Several; square, thin, 3 by 3 by 1.0 μm. **Feeding**: Carnivorous; eats small flagellates. **Habitat**: Marine; coastal waters. **Distribution**: Known from Gulf of Mexico, Florida, U.S.A. **References**: Morphology; distribution; description; Schaeffer (1926).



50 μm

Figure 23.—*Mayorella gemmifera*: A—radiate, afloat; B—wrinkled, at rest; C—actively locomotive; after Schaeffer (1926).

Mayorella gemmifera

Size: Locomotive, 40 to 50 μ m long. **Pseudopods**: Locomotive; few, short, bluntly conical, from clear, anterior wavelike bulges; long, slender in radiate stage. **Uroid**: None. **Ectoplasm**: Clear; distinct at anterior, advancing margin. **Endoplasm**: Finely granular. **Nucleus**: Spherical, 10μm diameter; with central endosome, 5μm diameter. **Water-expulsive vesicle**: None. **Food vesicles**: Usually present. **Other vesicles**: Few; form and shrink. **Crystals**: Many; about 1.0 μm long, probably bipyramidal with bases apposed. **Cyst**: Unknown. **Feeding**: Herbivorous, on algae. **Habitat**: Marine; in warm, coastal waters. **Distribution**: Known from Gulf of Mexico, Florida, U.S.A. **References**: Morphology; ecology; description; Schaeffer (1926).

C(A) Length over 100μm, no crystals . . . . . *M. conipes*
C(A) Length 100μm or less, no crystals . . . . . D

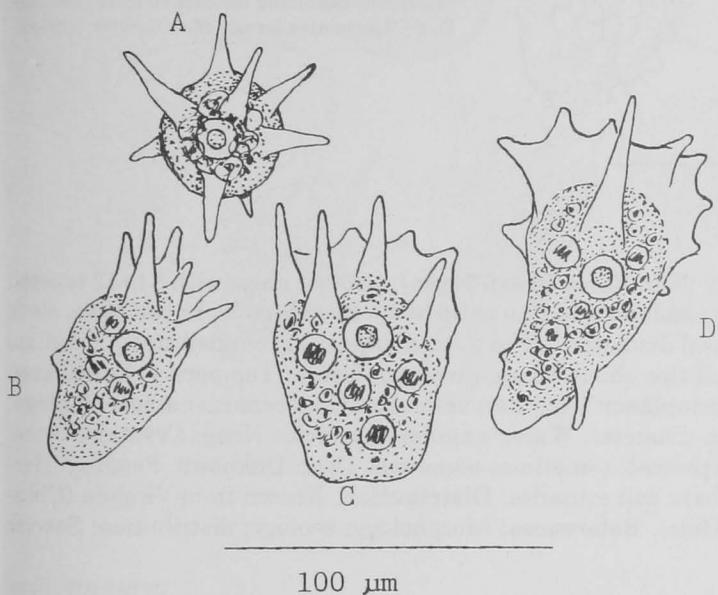


Figure 24.—*Mayorella conipes*: A—afloat, radiate; B, C, D—locomotive; after Schaeffer (1926).

Mayorella conipes

Size: Rounded, 30 to 40μm; radiate, body 20 to 30μm, with pseudopods, to 70μm; locomotive, 100 to 170μm long. **Pseudopods**: Clear, conical, with rounded tips; 5 to 20μm long, basal diameter 3 to 10μm, tips 1 to 3μm. **Ectoplasm**: Clear, distinct at anterior end. **Endoplasm**: Granular. **Nucleus**: Spherical; 10 to 20μm diameter, with central endosome 4 to 9μm diameter; division mitotic. **Uroid**: None. **Water-expulsive vesicle**: None. **Food vesicles**: Usually present, to 5 μm diameter. **Crystals**: None. **Feeding**: Herbivorous, on algae. **Habitat**: Marine; in coastal waters. **Distribution**: Known from Atlantic coastal waters, United States, Florida to New York. **References**: Morphology; ecology; description; Schaeffer (1926).

D(C) Length 50-100μm; nucleus 5μm in diameter . . . . . *M. corlissi*
D(C) Length 30-40μm; nucleus indistinct . . . . . *M. smalli*

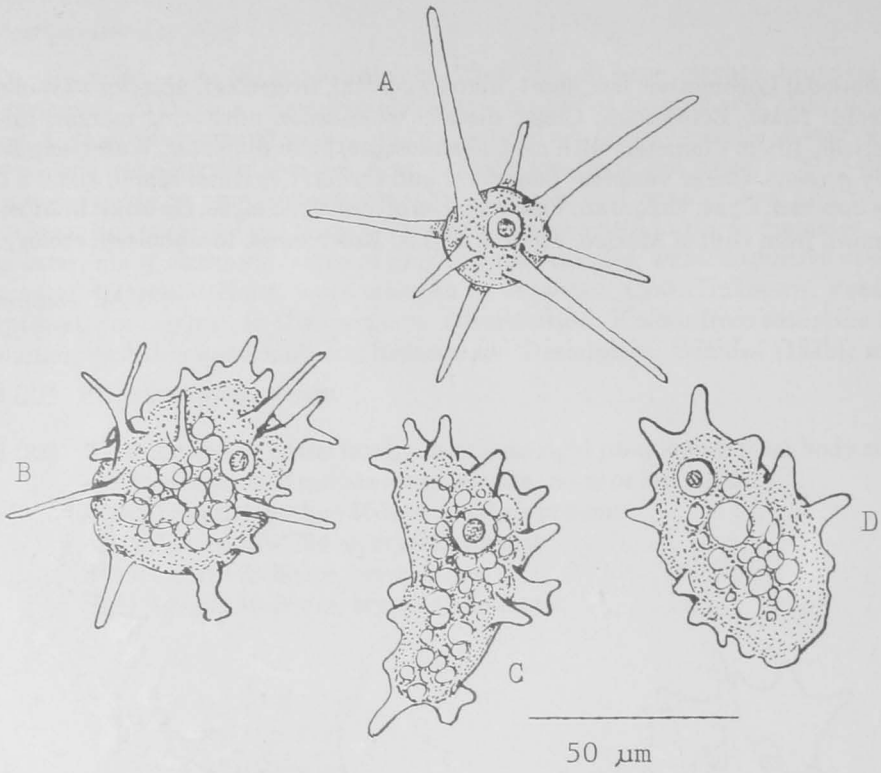


Figure 25.—*Mayorella corlissi*: A—radiate, afloat; B—beginning locomotion after floating; C, D—locomotive forms; after Sawyer (1975a).

Mayorella corlissi

Size: Locomotive, 50 to 100µm long (mean 60µm); width 28 to 40µm (mean 34µm). Radiate stage with 8 to 12 tapered pseudopods; body globular, about 20µm diameter; with pseudopods to 90 µm tip to tip. **Pseudopods**: Locomotive, clear from clear anterior margin, 4 to 7µm long, 3 to 4µm basal diameter, 1.5 to 2µm diameter at rounded tips. Of radiate stage, clear, 30 to 35µm long, basal diameter 3 to 4µm, at tips about 0.5µm diameter. **Uroid**: Temporary. **Ectoplasm**: Clear, thin; distinct at advancing end as clear margin. **Endoplasm**: Granular; vesiculated in locomotive stage. **Nucleus**: Spherical, 5µm diameter; with central endosome, 3µm diameter. **Water-expulsive vesicle**: None. **Crystals**: None. **Food vesicles**: Usually present. **Other vesicles**: Usually present; sometimes numerous. **Cyst**: Unknown. **Feeding**: Herbivorous, on algae. **Habitat**: Marine; shallow waters of bays and estuaries. **Distribution**: Known from Virginia (Chincoteague Bay) to Massachusetts (Salt Pond at Woods Hole). **References**: Morphology; ecology; distribution; Sawyer (1975a).

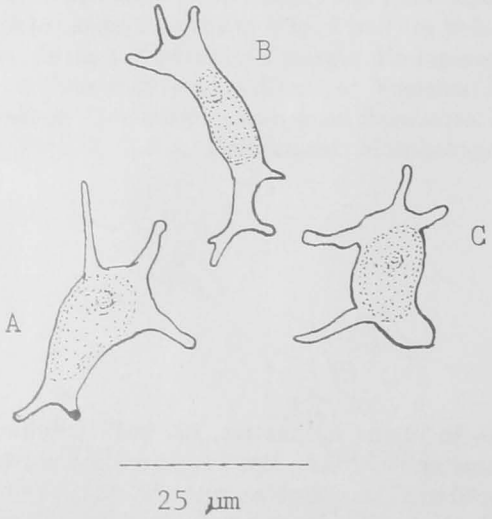


Figure 26.—*Mayorella smalli*: A, B, C—locomotive forms; after Sawyer (1975a).

Mayorella smalli

Size: Locomotive, 30 to 40µm long, 10 to 15µm wide, limaciform. **Pseudopods**: Clear, conical, in contact with substrate, 1 to 2µm diameter at base, about 1.0µm at tip, may spread to 2.0µm at tip when contacting substrate. **Uroid**

Temporary. **Ectoplasm**: Clear, evident at bases of pseudopods. **Endoplasm**: Finely granular. **Nucleus**: Not described. **Vesicles**: Not described. **Crystals**: None described. **Cyst**: Unknown. **Feeding**: Probably bactivorous. **Habitat**: Marine bays. **Distribution**: Atlantic coast of United States, Virginia, northward, extent unknown. **References**: Morphology; ecology; Sawyer (1975a).

23 (22) With characters of the family, similar to *Mayorella* but with multiple, elongate, pseudopods as **long as or longer than body mass** 24

24 (23) Elongate pseudopods swing laterally from bases during retraction . . . . . *Vexillifera* . . . A
A(24) Length less than 50μm; bactivorous . . . . . B
A(24) Length 60-80μm; herbivorous . . . . . *V. aurea*

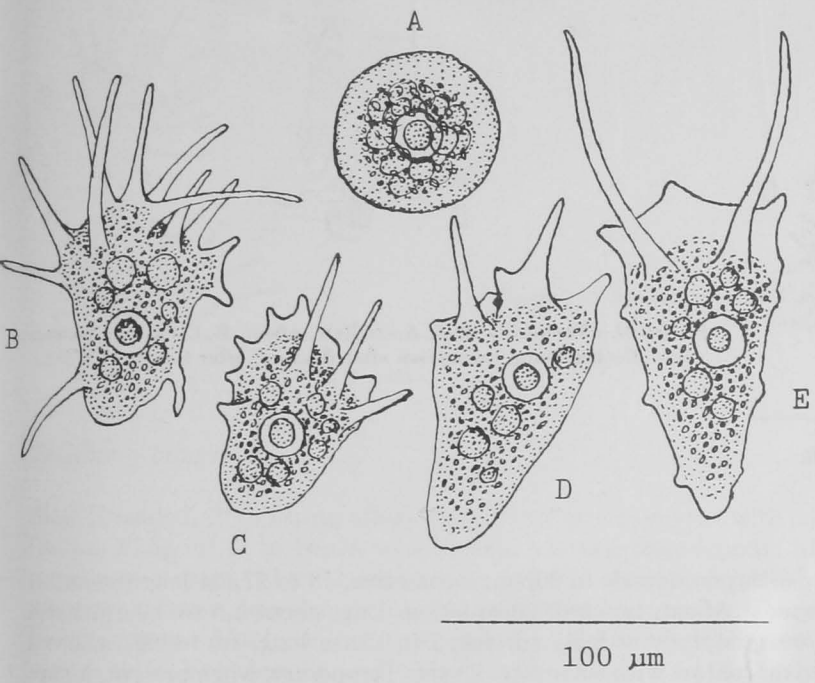


Figure 27.—*Vexillifera aurea*: A—rounded, at rest; B-E—locomotive; after Schaeffer (1926).

Vexillifera aurea

Size: Rounded, 25 to 30μm; subspherical 30 to 40μm with 2 to 4 long, tapered pseudopods; locomotive, ovoid, 60 to 80 µm long, 20 to 60μm wide with many pseudopods. **Pseudopods**: Clear, conical with round tips, 60 to 100μm long, 2 to 5 µm diameter at bases, 1 to 3μm at tips. **Uroid**: Absent. **Ectoplasm**: Clear. **Endoplasm**: Granular. **Nucleus**: Spherical, 15μm with central, round endosome 6μm. **Vesicles**: None. **Crystals**: None; but many yellowish granules. **Cyst**: Unknown. **Feeding**: Herbivorous; on diatoms. **Habitat**: Marine; coastal waters. **Distribution**: Known from Gulf of Mexico, Florida, U.S.A. **References**: Morphology; ecology; description; Schaeffer (1926).

B(A) Length 15-45μm; bactivorous . . . . . *V. telmathalassa*
B(A) Length 30μm or less; bactivorous C

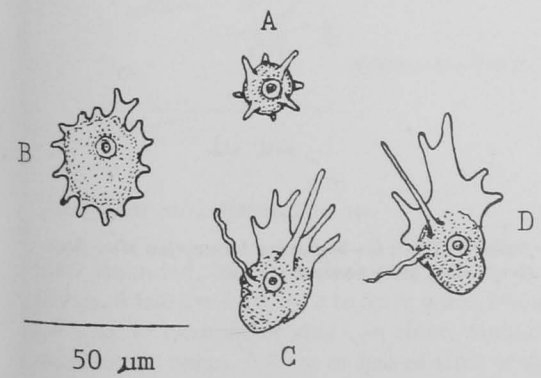


Figure 28.—*Vexillifera telmathalassa*: A—radiate, afloat; B—at rest, attached; C, D—locomotive; after Bovee (1956).

Vexillifera telmathalassa

Size: Rounded, 8 to 10μm; radiate, body 6 to 8μm diameter, with pseudopods to 45μm; locomotive, 15 to 45μm long. **Pseudopods**: 5 to 30μm long, from margin or body surface, 1 to 2μm diameter at bases, about 0.5μm at rounded tips, slightly flattened on contact with substrate. **Uroid**: None. **Ectoplasm**: Clear. **Endoplasm**: Finely granular. **Nucleus**: Spherical, 3μm diameter, with central endosome, 2μm. **Vesicles**: None. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Atlantic coast of United States, Florida to Massachusetts; also, Pacific Coast, southern California. **References**: Morphology; ecology; description; Bovee (1956), Mitchell and Yankofsky (1969).

C(B) Length 18-27μm; nucleus 5.6μm . . . . . *V. ottoi*

C(B) Length less than 25μm; nucleus 3μm or smaller . . . . . D

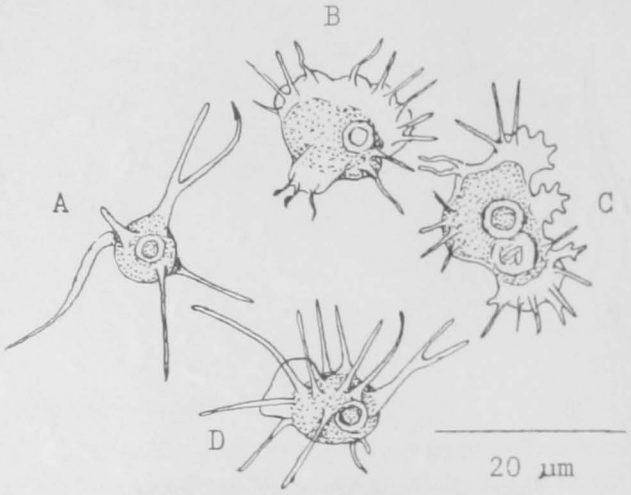


Figure 29.—*Vexillifera ottoi*: A—radiate, afloat; B, C—active, locomotive; D—beginning locomotion after floating; after Sawyer (1975a).

Vexillifera ottoi

Size: Afloat, irregular body 10 to 15μm diameter, with pseudopods to 60μm; locomotive, 18 to 27μm long (mean, 21 μm), 12 to 18μm wide (mean, 13.5μm). **Pseudopods**: Afloat, tapered, 20 to 60μm long, about 1.5 to 2.0μm basal diameter, less than 1.0μm at tips; locomotive, from periphery or body surface, 2 to 15μm long, 1.0 to 2.0μm basal diameter, less than 1.0μm at tips, slightly flattened on contact with substrate. **Uroid**: Temporary, when present, lobate or of short, fine filaments. **Ectoplasm**: Thin, pale, clear. **Endoplasm**: Finely granular. **Nucleus**: Spherical; distinct, 5 to 6μm diameter, with central endosome, 3 to 5μm diameter; division, mesomitotic. **Food vesicles**: Few to several, 3 to 5 μm diameter; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Shallow coastal waters; in bays, estuaries. **Distribution**: Known from Atlantic coast, United States, Virginia to Massachusetts. **References**: Morphology; ecology; description; Sawyer (1975a).

D(C) Length 14-18μm; nucleus ovate . . . . . *V. pagei*

D(C) Length less than 25μm; nucleus spherical, 3μm or less . . . . . E

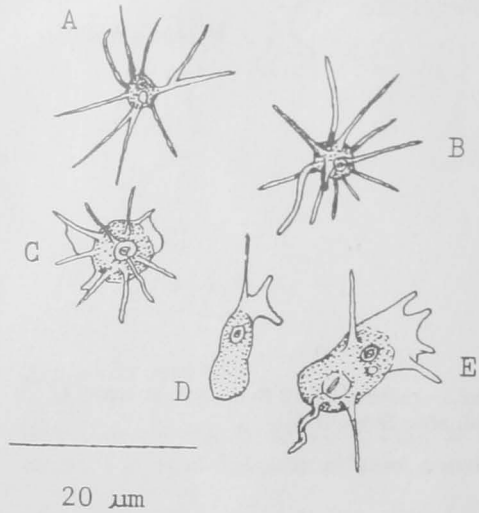


Figure 30.—*Vexillifera pagei*: A, B—radiate, afloat; C—beginning locomotion after floating; D, E—locomotive forms; after Sawyer (1975a).

Vexillifera pagei

Size: Rounded 5 to 6μm; radiate, body 5 to 6μm diameter with pseudopods to 35μm; locomotive, 14 to 18μm (mean, 16 μm), width 7 to 14μm (mean, 10μm). **Pseudopods**: Of radiate stage, to 15μm long, less than 0.5μm tips; locomotive, 1.5 to 8μm long, about 1.0μm diameter at bases, tapered to about 0.5μm at tips somewhat flattened in contact with substrate, 2 to 3μm wide with round tips, from body surface or margin, bend and swing as retracted. **Uroid**: None. **Ectoplasm**: Thin, pale, clear. **Endoplasm**: Finely granular. **Nucleus**: Ovate 3μm long, 2 to 7μm wide, with central endosome 2μm diameter; division mesomitotic with small polar granules. **Vesicles**: Absent. **Crystals**: None. Cyst: Unknown. **Feeding:** Bactivorous. **Habitat:** Marine; shallow bays and estuaries. **Distribution:** Known from Atlantic coast of United States, Virginia to Massachusetts. **References:** Morphology; ecology; description; Sawyer (1975a).

E(D) Length 14-23μm; nucleus 2.5-3μm . . . . . *V. browni*
E(D) Length 5-8μm; nucleus 1μm . . . . . *V. minutissima* n. sp.

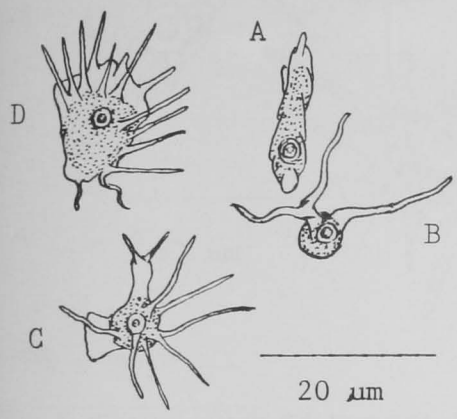


Figure 31.—*Vexillifera browni*: A, B—floating stages; C—beginning locomotion after floating; D—locomotive form; after Sawyer (1975a).

Vexillifera browni

Size: Rounded, 10 to 12μm; afloat, body 8 to 10μm diameter, with pseudopods 40 to 80μm; locomotive, 14 to 23μm long (mean, 16.5μm), 7 to 14μm wide (mean, 11μm). **Pseudopods**: Slender, tapered, clear; of radiate stage, irregular, sometimes twisted, 10 to 50μm long; of lomotive stage, from periphery or body surface, 8 to 30μm long, 1.0 to 2.0μm diameter at bases, less than 1.0μm at tips. **Uroid**: Temporary, filamentous. **Ectoplasm**: Clear, pale, thin. **Endoplasm**: Finely granular. **Nucleus**: Indistinct, spherical, 2.5 to 3.0μm diameter, with central endosome, 2μm diameter; division, mesomitotic. **Vesicles**: Several, mostly food vesicles, 2 to 10μm diameter; water-expulsive vesicle absent. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; in shallow bays, backwaters. **Distribution**: Atlantic coast, United States, Virginia to Massachusetts. **References**: Morphology; ecology; description; Sawyer (1975a).

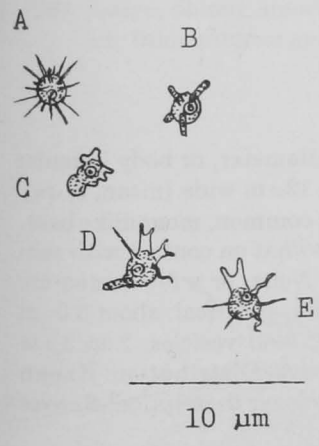


Figure 32.—*Vexillifera minutissima*: A—radiate, afloat; B—rounded, with attached bacteria; C—beginning locomotion; D, E—locomotive forms.

Vexillifera minutissima n. sp.

Size: Rounded, 3 to 4μm diameter; afloat, radiate, body mass 3μm diameter, with 20 to 24 slender, radiate pseudopods; motile, 5 to 8μm long by 3 to 5μm wide. **Pseudopods**: Of radiate stage, barely visible, less than 0.5μm diameter, 8 to 10 μm long; of locomotive stage, in clear, conical pairs from a clear anterior projection or projections, 2 to 3μm long, 0.5μm diameter at bases, 0.3μm or less at tips, or slender, filose, from body surface, 2 to 10μm long, wave as retracted. **Uroid**:

None. **Ectoplasm**: Clear, in pseudopods and advancing margin. **Endoplasm**: Light-refractile, faintly granular. **Nucleus**: Spherical, 1.0μm diameter or slightly less; endosome indistinct, less than 1.0μm diameter. **Vesicles**: One or two vesicles, often none. No water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous; attached bacteria digested at end attached. **Habitat**: Discovered in shallow water (bays, estuaries) Chincoteague Bay, Va. **Distribution**: Known from Virginia to Massachusetts, U.S.A.

24 (*23*) Similar to *Vexillifera* but with several slender pseudopods originating from a common base 25

25 (*24*) Pseudopods in groups of 2, 3, or 4 all arise from a common base on clear anterior advancing margin, or from body surfaces . . . . . *Triaenamoeba*

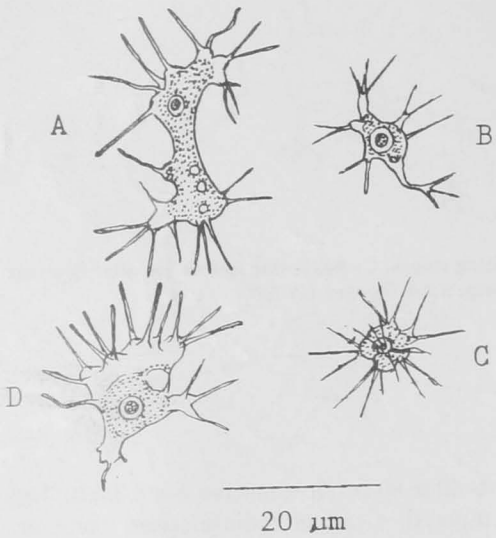


Figure 33.—*Triaenamoeba jachowskii*: A—extended form; B, C—floating forms; D—locomotive form; after Sawyer (1975a).

Triaenamoeba jachowskii

Size: Afloat, irregularly rounded, body 9 to 10μm diameter, with pseudopods, 40 to 50μm diameter, or body irregular with pseudopods to 60μm diameter; locomotive, 13 to 22.5μm long (mean, 17μm), by 7 to 12μm wide (mean, 9μm). **Pseudopods**: Clear, tapered; of locomotive stage, from body or periphery, one to several from common, moundlike base, 5 to 15μm long, slightly tapered, about 1.0μm diameter at base, less at the tip, flatten somewhat on contact with substrate; of radiate stage, numerous, less than 1.0μm diameter, 2.0 to 15.0μm long. **Uroid**: None, or a few temporary filaments. **Ectoplasm**: Pale, refractile, clear. **Endoplasm**: Finely granular. **Nucleus**: Indistinct, spherical, about 3.0 m diameter, with central endosome 2.0μm diameter; division, mesomitotic. **Vesicles**: Few; food vesicles, 2 to 3μm diameter; no others. **Crystals**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Known from Atlantic coast, United States, Virginia to Massachusetts. **References**: Morphology; ecology; description; Sawyer (1975a).

25 (*24*) Pseudopods in groups of 2 or more, originate only from clear advancing margin. Body limaciform in rapid locomotion; without conical pseudopods except in slow locomotion or while changing from radiate floating form 26

26 (*25*) Stellate floating form. Changes to spread form with conical pseudopods when beginning locomotion, and to limaciform in forward locomotion . . . . . *Striolatus tardus*

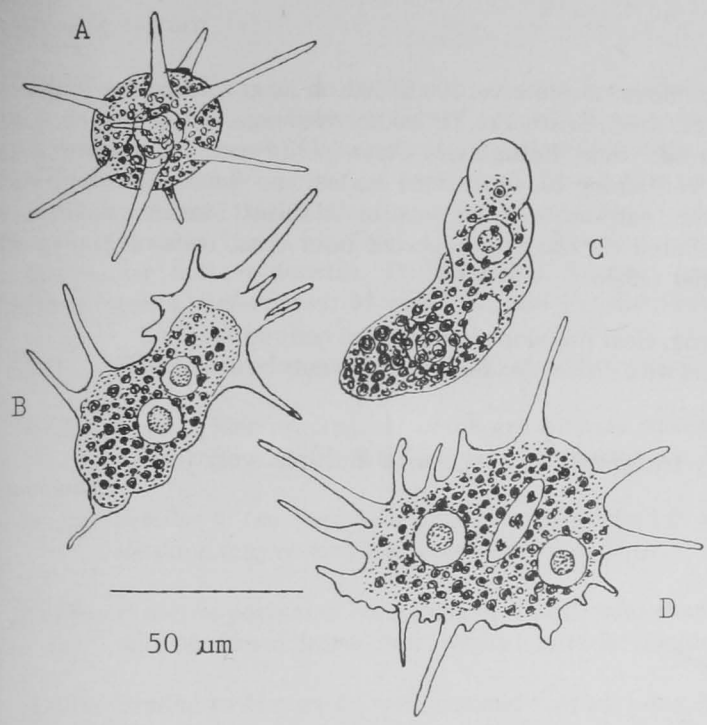


Figure 34.—*Striolatus tardus*: A—radiate, afloat; B—beginning locomotion; C—feeding, active stage; D—slowly locomotive; after Schaeffer (1926).

Striolatus tardus

Size: Contracted, 30 to 40 µm across, discoidal; radiate, body 15 to 20 µm, with pseudopods to 60 µm diameter. **Pseudopods**: Of radiate stage, clear, conical 15 to 20 µm long, basal diameter 8 to 10 µm, tips 2 to 3 µm diameter; of active stage, clear, conical 5 to 40 µm long, basal diameters 2 to 10 µm, tips 1 to 3 µm; of locomotive stage, slowly formed, clear bulges at anterior end, 20 to 25 µm diameter. **Uroid**: None. **Ectoplasm**: Clear, distinct, glossy. **Endoplasm**: Finely granular. **Nucleus**: Mononucleate or binucleate; each spherical, 10 µm diameter, with endosome 5 µm diameter. **Vesicles**: Several, clear 10 to 15 µm diameter; no water-expulsive vesicle. **Crystals**: None, but many bright granules. **Cyst**: Unknown. **Feeding**: Herbivorous; eats diatoms. **Habitat**: Marine; in shallow, coastal waters. **Distribution**: Known from Atlantic coastal waters, United States, Florida to New Jersey. **References**: Morphology; ecology; description; Schaeffer (1926).

26 (25) Body flattened, limaciform to oblong with longitudinal ridges and short conical pseudopods, or somewhat rounded with many relatively long, clear pseudopods from peripheral body surface 27

27 (26) Large, oblong amoebae with longitudinal ridges and short bristlelike, pointed pseudopods arising from anterior and lateral margins of body . . . . . *Pontifex maximus*

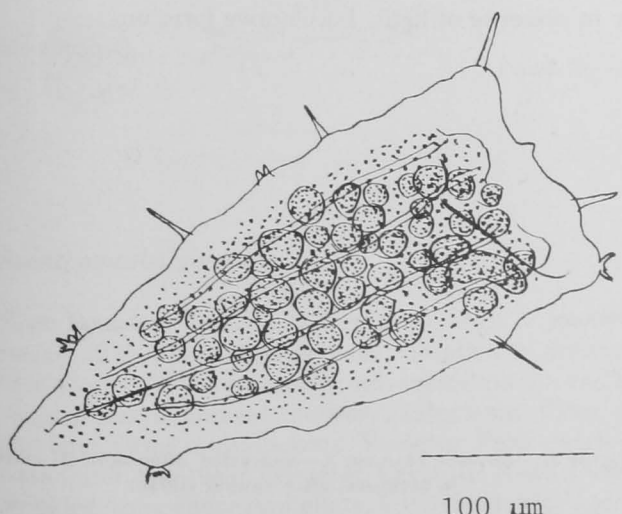


Figure 35.—*Pontifex maximus*: after Schaeffer (1926).

Pontifex maximus

Size: Rounded, 100 to 150 μm; radiate, 100 to 150 μm diameter; locomotive, 100 to 500 μm long, trapezoidal, with 2 to 5 dorsal, longitudinal ridges. **Pseudopods**: Of radiate stage, short, bristlelike. Of locomotive stage, few, spinelike, mostly 10 to 12 μm long; from anterior margin and sides. **Uroid**: None. **Ectoplasm**: Clear, peripheral. **Endoplasm**: Finely granular. **Nucleus**: Obscured. **Vesicles**: 5 to 10 μm, containing brownish food masses; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous; eats brown algal detritus. **Habitat**: Marine; shallow, cool waters. **Distribution**: Coastal waters, northeastern United States; also reported from coral reefs of Madagascar. **References**: Morphology; ecology; description; Schaeffer (1926).

27 (26) Large amoebae of variable shape, numerous, long, clear pseudopods arise from body surface and advancing margin. Nucleus large, spherical, and with distinct endosome which may be obscured by refractile, ingested, plant debris 28

28 (27) Similar to *Mayorella* and *Vexillifera*, broadly triangulate in shape with multiple, very long, conical pseudopods . . . . . *Dinamoeba*

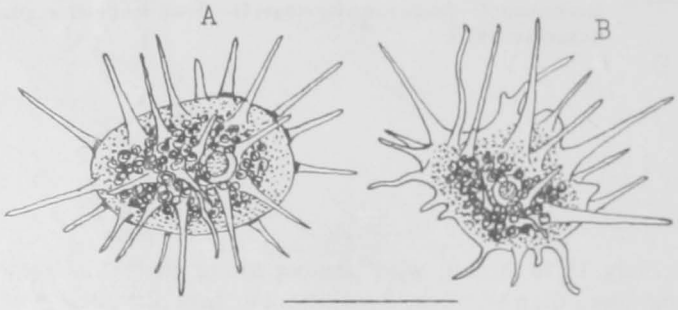


Figure 36.—*Dinamoeba acuum*: A—radiate form; B—active form; after Schaeffer (1926).

Dinamoeba acuum

Size: Rounded, 20 to 30 μm; radiate, body 20 μm across, with pseudopods, to 140 μm across. **Pseudopods**: Clear, conical, round-tipped from advancing margin and body, 10 to 60 μm long, 5 to 10 μm basal diameter, tapered to round tips, 2 to 3 μm, wrinkle, coil in retraction. **Uroid**: None. **Ectoplasm**: Clear, as anterior margin and pseudopods. **Endoplasm**: Clear, finely granular. **Nucleus**: Spherical, 10 to 12 μm diameter, with endosome 5 to 6 μm diameter. **Vesicles**: Numerous, 2 to 10 μm diameter; also brownish globules, 3 to 5 μm. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous; on small algae. **Habitat**: Marine; shallow, muddy, coastal waters. **Distribution**: Known from Gulf of Mexico and Atlantic coastal waters, United States. **References**: Morphology; ecology; description; Schaeffer (1926).

28 (27) Pseudopods very long and slender, multiple or few. Body form variable 29

29 (28) Pseudopods multiple and elongate, retract quickly in presence of light. Locomotive form unknown . . . . . *Boveella obscura*

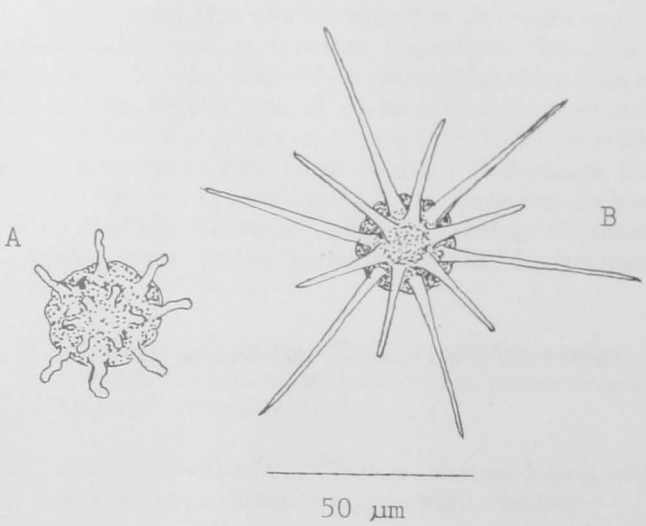


Figure 37.—*Boveella obscura*: A—contracted, after light; B—extended in darkness; after Sawyer (1975a).

Boveella obscura

Size: Contracted, ovoid, 20 by 30 μ m; radiate form, body 20 μ m diameter, covered by debris and diatoms, with pseudopods to 100 μ m between tips of opposite filose pseudopods; locomotive stage, unknown. **Pseudopods**: Of contracted state, remnants of long pseudopods; of radiate stage, 40 to 50 μ m long, clear, conical, basal diameter 3 to 4 μ m, tapered to about 1.0 μ m at tips; pseudopods from upper surface when attached, radiate from entire body when afloat. **Ectoplasm:** Clear, thin. **Endoplasm:** Finely granular. **Nucleus:** Unknown, due to debris on body. **Vesicles:** Also unknown. **Crystals**: Unknown. **Cyst**: Unknown. **Feeding**: Probably herbivorous; on diatoms. **Habitat**: Marine; shallow bays, under bottom detritus. **Distribution**: Atlantic coastal waters, United States, reported from Virginia to Massachusetts. **References**: Morphology; ecology; distribution; Sawyer (1975a).

29 (28) Pseudopods elongate, few in number with one usually much longer than others 30

30 (29) Several long pseudopods which are actively waved; one may anchor to substrate with rest of amoeba flowing into it before resuming locomotion. No marine species known . . . . . *Oscillosignum*

30 (29) Similar to *Oscillosignum* but body awl-shaped in active locomotion. Anterior-most pseudopod long and may resemble a broad based flagellum 31

31 (30) Posterior portion of body expanded and wider than anterior portion. Awl-shaped in locomotion with one broad based, clear, conical, anterior pseudopod. No marine species known . . . . . *Subulamoeba*

31 (30) Similar to *Mayorella*, body not awl-shaped. Long, thin, vibratile anterior pseudopod very much like a flagellum. No marine species known . . . . . .*Flagellipodium*

32 (21) Pseudopods numerous, short, and spiny; single or in groups along anterior margin and on all body surfaces. Form triangulate or elongate in locomotion. Uninucleate with distinct round endosome; division by mesomitosis or metamitosis. Cysts round, polygonal, or stellate; ectocyst wrinkled, rippled, or nearly smooth, with or without distinct operculae . . . . . .*Acanthamoebidae* . . . A
A(32) Cysts polygonal . . . . . .*A. gigantea*
A(32) Cysts stellate . . . . . .*A. griffini*

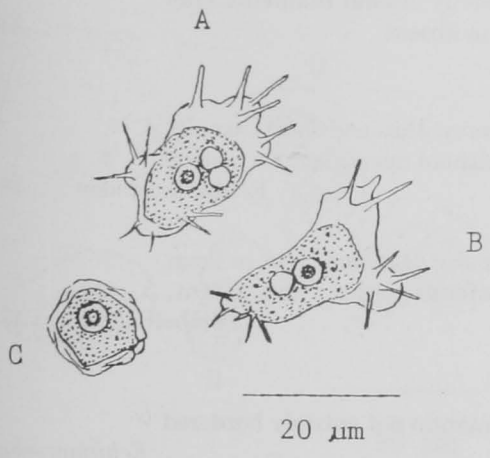


Figure 38.—*Acanthamoeba gigantea*: A, B—locomotive forms; C—cyst; after Schmöller (1964).

Acanthamoeba gigantea

Size: Rounded, 7 to 20 μ m (mean, 15 μ m); locomotive, trapezoidal to triangular, 15 to 40 μ m long by 7 to 20 μ m wide (mean, 30 by 16μ m). **Pseudopods**: Eruptive bulges at anterior margin; also slender, tapered, clear, 5 to 7μm long, singly or in groups of 2 to 4 from clear, advancing margin and body. **Uroid**: Temporary, when present. **Ectoplasm**: Clear, as advancing margin and pseudopods. **Endoplasm**: Clear, granular. **Nucleus**: Spherical, 5 to 6μm, with endosome 3.5 to 4 μm; large forms multinucleate. **Vesicles**: Food vesicles, food globules, 2 to 5μm; water-expulsive vesicle in brackish or fresh water, 8 to 10μm diameter. **Crystals**: None. **Cyst**: 13 to 22μm diameter, usually 15 to 17μm; two-layered; ectocyst wrinkled, thin; endocyst stellate, 5 or 6 sided, with operculae. **Feeding**: Bactivorous; scavenging. **Habitat**: Marine; shallow coastal waters; tolerates fresh water. **Distribution**: Known from Atlantic coastal waters of Europe and United States; probably worldwide. **References**: Morphology; ecology; description; Schmöller (1964).

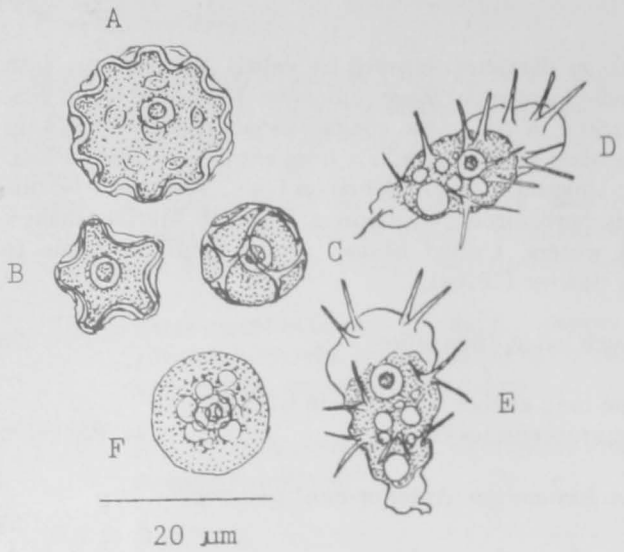


Figure 39.—*Acanthamoeba griffini*: A—cyst, in distilled water; B—cyst in 27‰ seawater; C—cyst in 35‰ seawater; D, E—locomotive forms; F—rounded precystic forms; after Sawyer (1971).

Acanthamoeba griffini

Size: Rounded, 10 to 15 µ m; locomotive, 23 to 41 µ m long by 9 to 16 µ m wide (mean, 29.5 by 13.0 µ m), more or less triangular. **Pseudopods**: Blunt, eruptive bulges from clear margin in locomotion; also, slender, tapered 3 to 10µ m long, singly or in groups of 2 to 5 from body and clear margin. **Uroid**: An ectoplasmic bulb, temporary. **Ectoplasm**: Clear, as anterior margin and pseudopods. **Endoplasm**: Clear, granular. **Nucleus**: Spherical, 5 to 7µ m, with endosome 3 to 5µ m; division mesomitotic, no centrioles. **Vesicles**: Small food vesicles and food globules, 2 to 4µ m; water-expulsive vesicle in brackish water, 7 to 10µ m diameter. **Crystals**: None. **Cyst**: Mean diameter, 15.8µ m; endocyst thick, stellate, 3 to 6 rays; ectocyst thin, wrinkled. **Feeding**: Bactivorous. **Habitat**: Marine or brackish shallow water; tolerates fresh water. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Connecticut, probably cosmopolitan. **References**: Morphology; growth; division; description; Sawyer (1971).

32 (*21*) Similar to Acanthamoebidae. Several to many fine pseudopods; short, slender, and produced mainly from advancing margin but not from body surfaces. Numerous uroidal filaments may extend posteriorly in locomotive forms. Cysts round with operculae, or absent 33

33 (*32*) Body usually longer than broad in locomotion. Pseudopods few to many, thin and short; usually produced from clear advancing margin. Cysts round, smooth, and without operculae. No marine species known . . . . . Echinamoebidae . . . 34

33 (*32*) Body usually broader than long in locomotion. Pseudopods few to many, thin and short or long; usually produced from clear advancing margin and from trailing posterior border. Cysts absent, or as spherical pseudocysts which do not resist drying . . . . . Flabellulidae . . . 35

34 (*33*) Pseudopods few, produced mainly from anterior margin. Anterior margin not entirely bordered by clear hyaline zone. No marine species known . . . . . *Echinamoeba*

34 (*33*) Pseudopods thin, numerous; produced from anterior and lateral borders of advancing margin. No marine species known . . . . . *Filamoeba*

35 (*33*) Pseudopods of locomotive form numerous and short; anterior margin irregular or serrate with a few deep scurs. Uroid pronounced, formed by trailing posterior filaments . . . . . *Flabellula* . . . A
A(35) Length 15-75µ m, anterior margin with deep scurs. Uroidal filaments pronounced, numerous. Nucleus 4-6µ m in diameter . . . . . *F. citata*
A(35) Length less than 50 µ m; uroidal filaments variable. Nucleus less than 5 µ m . . . . . B

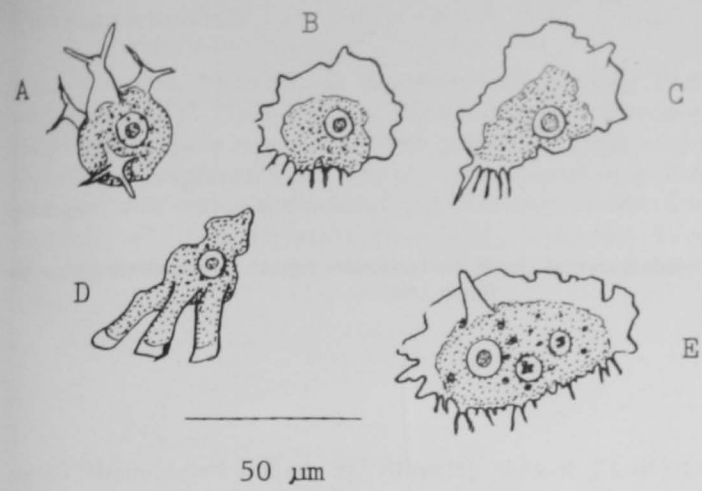


Figure 40.—*Flabellula citata*: A—radiate, afloat; B, C, E—locomotive forms; D—lobed form when disturbed; after Schaeffer (1926).

Flabellula citata

Size: Rounded, 8 to 12μm diameter; radiate, body 6 to 10μm diameter, with pseudopods to 35μm; locomotive, fan-shaped with clear, broad, fan-shaped anterior, 15 to 75μm long by 25 to 55μm wide. **Pseudopods**: Clear, conical, round-tipped, from margin and body, 5 to 10μm long, 2 to 3μm diameter at base, 1 to 1.5μm at tips. **Uroid**: Of several to many filaments at rear of body. **Ectoplasm**: Clear, distinct in pseudopods and anterior margin. **Endoplasm**: Finely granular. **Nucleus**: Spherical, 4 to 6μm diameter, with endosome, 2 to 3μm; division, mesomitotic. **Water-expulsive vesicle**: None in seawater; 5 to 6μm in brackish water; no other vesicles. **Crystals**: None. **Granules**: Several, 1 to 2μm, light-refractile. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; brackish waters of shallow bays and estuaries. **Distribution**: Known from Atlantic coast, United States, Florida to Maine. **References**: Morphology; ecology; distribution; Page (1971a), Schaeffer (1926), Bovee (1965).

B(A) Length variable, 8-22μm; uroidal filaments few, short. Nucleus 2-3μm . . . . . *F. calkinsi*
B(A) Length 20-40 μm; uroidal filaments variable. Nuclear diameter variable C

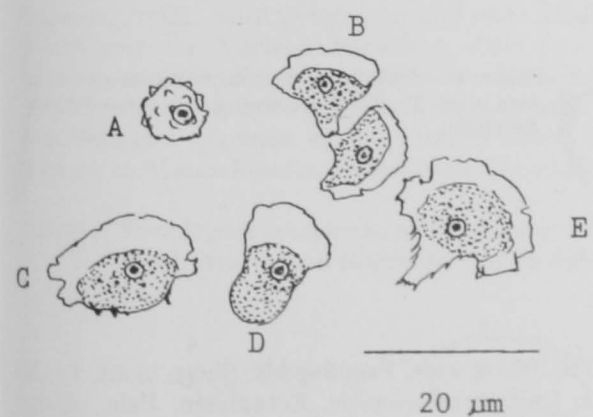


Figure 41.—*Flabellula calkinsi*: A—contracted form; B—dividing form; C, D, E—locomotive forms; after Hogue (1914).

Flabellula calkinsi

Size: Contracted, irregularly rounded, 5 to 10 μm; radiate, body 4.5 to 7.0 μm across, with pseudopods to 25 μm; locomotive, fan-shaped, 8 to 22μm long, by 12 to 35μm wide. **Pseudopods**: Clear, conical, 2 to 5μm long, or as scurs at irregular anterior margin. **Uroid**: Few, short filaments at rear. **Ectoplasm**: Clear, as anterior margin and pseudopods. **Endoplasm**: Finely granular. **Nucleus**: Spherical, 2 to 3μm, with central endosome 1.0 to 1.5μm; division, mesomitotic. **Vesicles**: Few. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; bays and estuaries. **Distribution**: Known from Atlantic coastal waters, United States, Maryland to Maine. **References**: Morphology; description; ecology; Hogue (1914), Page (1971a); division; Page (1971a).

C(B) Length 21μm or slightly more or less; uroidal filaments few; nucleus 5μm . . . . . *F. patuxent*
C(B) Length 25-40μm; uroidal filaments numerous. Nucleus less than 5μm . . . . . .D

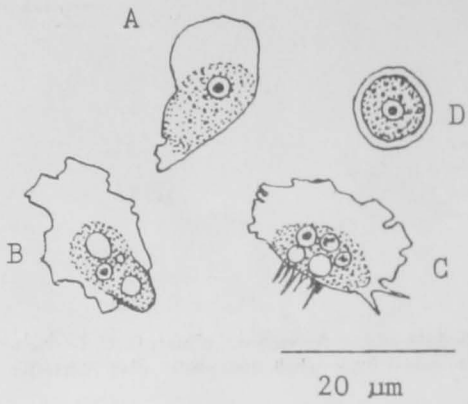


Figure 42.—*Flabellula patuxent*: A, B, C—locomotive forms; D—presumed cyst; after Hogue (1921).

Flabellula patuxent

Size: Rounded, 10 to 13 µm; locomotive, mean size 21 µm long by 13 µm wide, generally fan-shaped. **Pseudopods**: Clear, conical, or as blunt scurs from clear, anterior margin in locomotion. **Uroid**: Of several filaments at trailing end. **Ectoplasm**: Clear, as anterolateral margin of fan-shaped body. **Endoplasm**: Clear, granular. **Nucleus**: Spherical, about 5 µm, with endosome about 3 µm. **Vesicles**: Numerous food vesicles, 3 to 6 µm diameter. **Crystals**: None. **Cyst**: Round, 3 to 18 µm, 3-layered. **Feeding**: Bactivorous; scavenging. **Habitat**: Commensal in gut of oysters; also free living. **Distribution**: Known from Atlantic coast, United States. **References**: Morphology; culturing; description; Hogue (1921).

D(C) Length 20-40µm; uroidal filaments numerous, trailing. Nuclei 15-20 in number, diameter 1.5µm *F. pellucida*

D(C) Length 13-27 µm; uroidal filaments variable. Nucleus single, 4-4.5µm . . . . . E

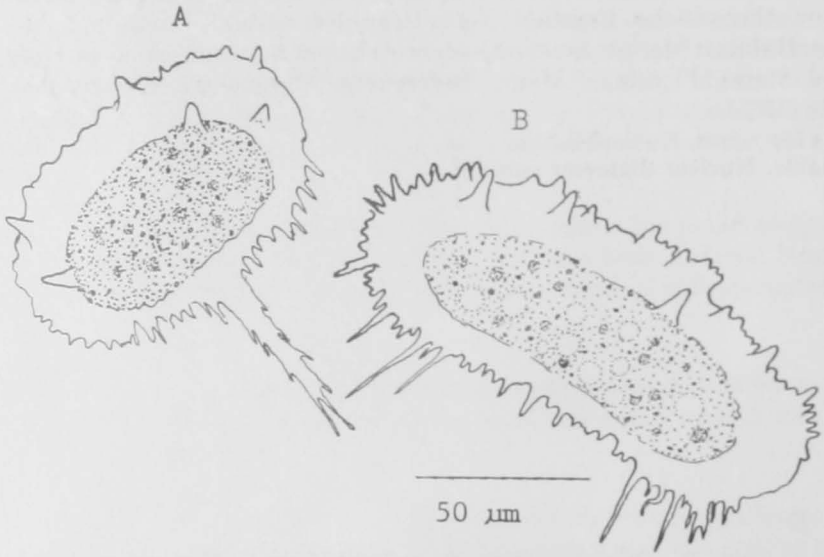


Figure 43.—*Flabellula pellucida*: A—locomotive, with long uroid; B—broad, locomotive form; after Schaeffer (1926).

Flabellula pellucida

Size: Rounded, 30 to 40 µm diameter; locomotive, 20 to 40 µm long, 60 to 100 µm wide. **Pseudopods**: Short, blunt, 3 to 6 µm long, at periphery. **Uroid**: Several filaments derived from old, trailing pseudopods. **Ectoplasm**: Pale, clear, peripheral. **Endoplasm**: Pale, clear, faintly granular. **Nuclei**: 15 to 20, each spherical, 1.5 µm diameter. **Vesicles**: Absent. **Crystals**: Absent. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; coastal waters. **Distribution**: Known from Gulf of Mexico, Florida, U.S.A. **References**: Morphology; ecology; description; Schaeffer (1926).

E(D) Length 16-25 µm; uroidal filaments numerous, short. Nucleus 4 µm . . . . . *F. reniformis*

E(D) Length 13-27 µm; uroidal filaments numerous, long, and trailing. Nucleus 4.5 µm. Forms nonresistant round pseudocysts . . . . . *F. hoguae*

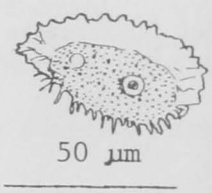


Figure 44.—*Flabellula reniformis*: after Schmöller (1964).

Flabellula reniformis

Size: Rounded, 10 to 20 μm diameter; radiate, body 10 to 20 μm diameter, with pseudopods to 60 μm diameter; locomotive, 16 to 25 μm long, by 16 to 45 μm wide. **Pseudopods**: Of radiate stage, tapered, round-tipped, 10 to 20 μm long; of locomotive stage, from clear, anterior margin, conical, 2 to 5 μm long, with round tips. **Uroid**: Temporary, of filaments. **Ectoplasm**: Clear, mainly at anterior margin. **Endoplasm**: Clear, finely granular. **Nucleus**: Spherical, 4 μm diameter, with central endosome, 2 μm diameter; division intranuclear, mitotic. **Vesicles**: Few; food vesicles, 3 to 5 μm diameter; no others. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Coastal brackish water, with algae. **Distribution**: Atlantic coastal waters; Europe. **References**: Morphology; ecology; growth; description; Schmöller (1964).

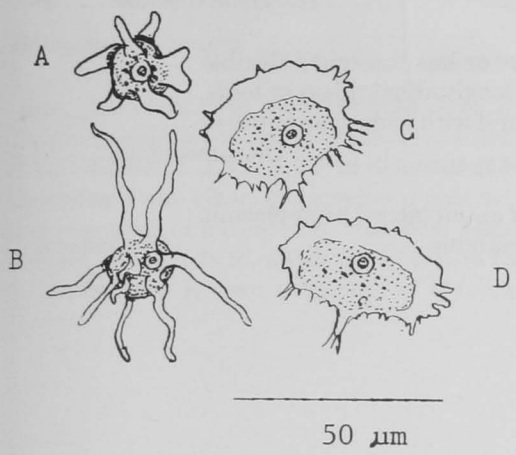


Figure 45.—*Flabellula hoguae*: A, B—radiate, afloat; C, D—locomotive; after Sawyer (1975a).

Flabellula hoguae

Size: Rounded, 10 to 12 μm; radiate, body 9 to 11 μm, with pseudopods to 75 μm; locomotive, fan-shaped 18 to 27 μm long (mean, 26 μm), width 18 to 45 μm (mean, 34 μm). **Pseudopods**: Of radiate stage, clear, conical, 10 to 50 μm long, basal diameter 3 to 4 μmm, tips 1.5 to 2.0 μm; locomotive, as short cones from body or advancing margin, 2 to 5 μm long; advancing margin clear, with serrate edge and scurs. **Uroid**: A few filaments, up to 25 μm long. **Ectoplasm**: Clear. **Endoplasm**: Finely granular. **Nucleus**: Indistinct, about 4.5 μm diameter, with central endosome 3 to 3.5 μm or of 2 or 3 separate smaller granules; division, mesomitotic. **Vesicles**: Water-expulsive vesicle absent in seawater; 3 to 5 μm in brackish; some food vesicles, 2 or 3 μm diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays and estuaries; shallow coastal waters on rocks. **Distribution**: Known from Atlantic coast, United States, Florida to Massachusetts. **References**: Morphology; ecology; description; Sawyer (1975a).

35 (33) Pseudopods numerous, short; produced from anterior margin and body surface. Width of body much greater than length. No uroidal filaments or cysts . . . . . *Flamella magnifica*

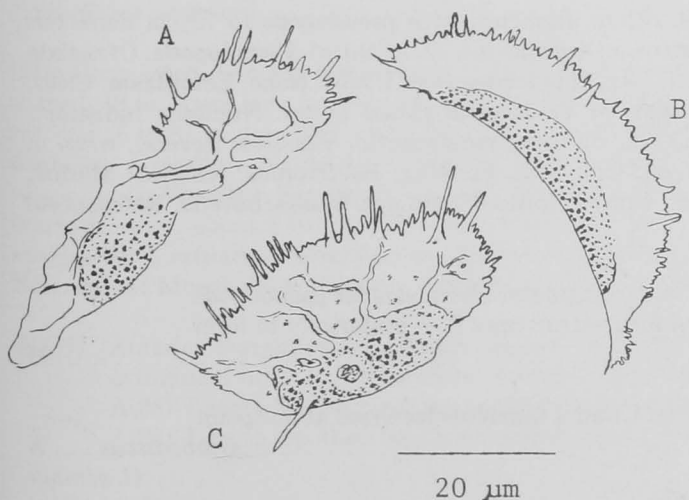


Figure 46.—*Flamella magnifica*: A-C—locomotive forms; after Schaeffer (1926).

Flamella magnifica

Size: Locomotive, 30 to 60μm long, 30 to 60μm wide, outline rapidly changeable. **Pseudopods**: From margin and body surface, clear, conical, 1 to 10μm long, fuse with clear, advancing margin, like veins. **Uroid**: None. **Ectoplasm**: Pale, clear. **Endoplasm**: Faintly granular. **Nucleus**: Indistinct; not described. **Vesicles**: Food vesicles, 3 to 5μm diameter; no others. **Crystals**: Few, small, bipyramidal to 2.0μm. **Cyst**: Unknown. **Feeding**: Herbivorous; on algae. **Habitat**: Marine; coastal waters. **Distribution**: Gulf of Mexico, Florida, U.S.A. **References**: Morphology; description; Schaeffer (1926).

36 (*18*) Body in locomotion discoid or broadly ovoid with central or postcentral granular hump surrounded completely, or almost completely, by a clear, flattened, hyaline zone; with or without longitudinal ridges extending beyond body margins. Uninucleate with large central endosome, rarely binucleate; nucleus spherical or slightly ellipsoid . . . . . Hyalodiscidae . . . 37

36 (*18*) Body in locomotion variable ovoid, oblong, or trapezoidal with more or less thickened flexible plasmalemma or "pellicle." Dorsal surface smooth, rippled, or with longitudinal ridges or folds. Pseudopods indistinct in locomotion or as lobate bulges. Nucleus round with endosome entire or fragmented. Cysts absent . . . . . Thecamoebidae . . . 39

37 (*36*) Granular endoplasm as postcentral mound, dragged by movement of anterolateral protoplasmic flow. Body sometimes with dorsal ridges which extend beyond body margins . . . . . *Hyalodiscus*

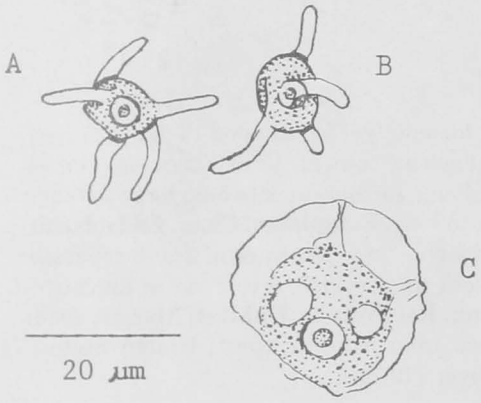


Figure 47.—*Hyalodiscus angelovici*: A, B—radiate, floating forms; C—locomotive form; after Sawyer (1975b).

Hyalodiscus angelovici

Size: Rounded, 25μm diameter; radiate, body mass about 20μm diameter, with pseudopods to 70μm diameter; locomotive, broadly ovate 24 to 38μm long by 22 to 34μm wide (mean dimensions, 32 by 29μm). **Pseudopods**: Of radiate stage, cylindroid, 20 to 25μm long, 3.5 to 6.0μm diameter; none formed in locomotion. **Uroid**: None. **Ectoplasm**: Clear, distinct as broad, anterolateral margin. **Endoplasm**: Granular, as postcentral raised hump. **Nucleus**: Indistinct, spherical, 4.0 to 4.5μm diameter, with endosome 3.0 to 3.5μm; division, mesomitotic. **Vesicles**: Several, when in brackish water; none to few in seawater. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays, estuaries. **Distribution**: Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; division; description; Sawyer (1975b).

37 (*36*) Similar to *Hyalodiscus*, body in locomotion more or less triangulate. Short, slender pseudopods along anterior margin, cylindrical in shape and used for feeding; may flow posteriorly to form temporary weak uroids 38

38 (*37*) Anterior pseudopods pincerlike as food cups for feeding. Uroidal filaments localized at midpoint of posterior margin. . . . . .*Gibbodiscus* . . . A
A(38) Length 35-40μm; nucleus 5μm. Crystals few . . . . . *G. gemma*
A(38) Length 18-24μm; nucleus 4.5μm. Crystals absent . . . . . *G. newmani*

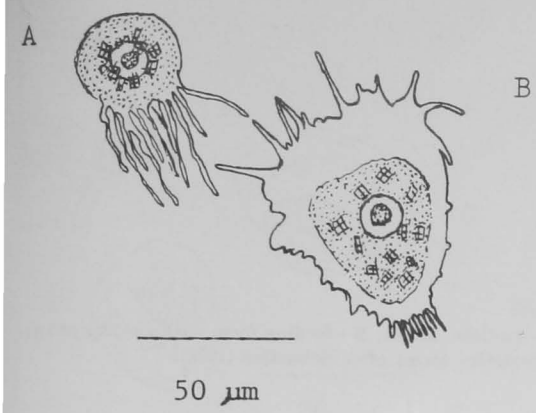


Figure 48.—*Gibbodiscus gemma*: A—medusa-like floating form; B—locomotive form; after Schaeffer (1926).

Gibbodiscus gemma

Size: Rounded, 15 to 20μm; radiate, body 15μm diameter, short pseudopods at one side; locomotive, 35 to 40μm long, 25 to 30μm wide, with clear peripheral margin, widest anteriorly. **Pseudopods**: Clear, conical 5 to 30μm long, 2.0 to 4.5μm basal diameter, 1.0 to 1.5 μ m diameter at tips, formed anteriorly, diverted to sides. **Uroid**: Filamentous; temporary. **Ectoplasm**: Pale, clear, as peripheral margin. **Endoplasm**: Flocculent, appears "milky," as postcentral region, about 40 μm diameter in locomotion. **Nucleus**: Spherical, 5μm, with central endosome, 3μm. **Vesicles**: None. **Crystals**: Few; square, 1.0 to 5.0μm, about 0.5 to 1.0μm thick. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; in tide pools. **Distribution**: Known from Gulf of Mexico, Florida, U.S.A. **References**: Morphology; ecology; description; Schaeffer (1926).

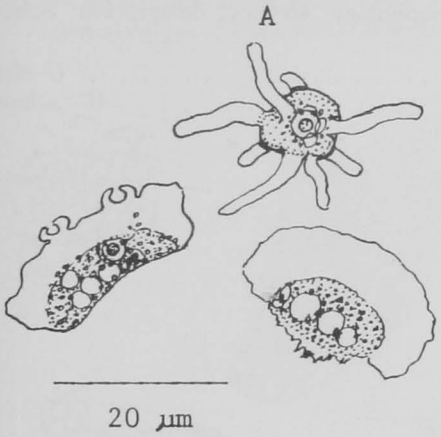


Figure 49.—*Gibbodiscus newmani*: A—radiate, afloat; B—feeding form with cup-like phagopods; C—locomotive form; after Sawyer (1975b).

Gibbodiscus newmani

Size: Contracted, 8 to 10μm diameter; radiate, body 6 to 8μm diameter, with pseudopods, to 35μm; locomotive, fan-shaped, 18 to 24μm long by 16 to 29μm wide (means, 21 by 23μm). **Pseudopods**: Of radiate stage, cylindroid, 18 to 25 μm long, 6 to 8μm diameter, clear, bluntly rounded tips. **Ectoplasm**: Clear, glossy, forms anterolateral margin. **Endoplasm**: Granular. **Nucleus**: Spherical, 4.5 μm, with central endosome, 3.5 to 4.0 μm diameter; division by mesomitosis. **Vesicles**: Several, 3 to 8μm diameter; food vesicles, 2 to 5μm diameter; forms water-expulsive vesicle in brackish water, about 6 to 7μm diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays, estuaries. **Distribution**: Known from Atlantic coastal waters, United States, Florida to Massachusetts. **References**: Morphology; division; description; Sawyer (1975b).

38 (37) Anterior margin smooth, forms shallow, endocytic, food vesicles for feeding; short, tubular or cylindrical tubes may form along lateral margins for feeding. Posterior margin irregular . . . . . *Unda* . . . A
A(38) Length 50μm or greater; nuclear diameter 4μm . . . . . *U. maris*
A(38) Length less than 50μm; nuclear diameter 4-4.5μm . . . . . B

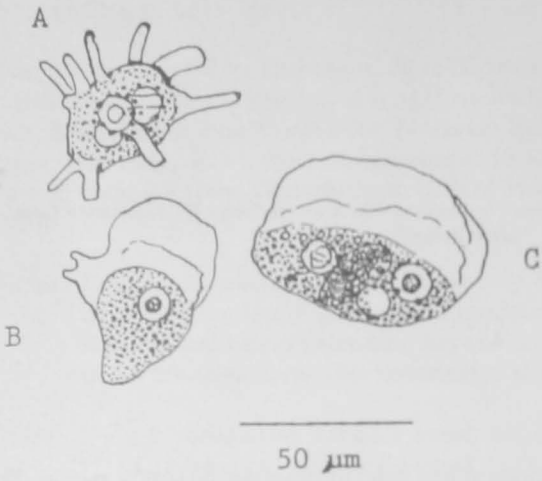


Figure 50.—*Unda maris*: A—radiate, afloat; B—feeding form with cuplike phagopod; C—locomotive form; after Schaeffer (1926).

Unda maris

Size: Rounded, 20 to 25µm; radiate, body mass 18 to 20µm diameter, with pseudopods, to 25µm; locomotive, 20 to 40 µm long by 25 to 45µ m wide. **Pseudopods**: Of radiate stage, short, cylindroid, 2 to 3µm long, 1.5µ m diameter, clear, round-tipped; of locomotive stage, flat, tonguelike extensions of clear anterior margin, 10 to 15µ m long by 10 to 15µ m broad, or as food cups of similar dimensions. **Uroid**: None. **Ectoplasm**: Clear, as series of waves at advancing margin, one over another. **Endoplasm**: Granular, clear. **Nucleus**: Spherical, 10µ m; with endosome, 5µ m diameter. **Vesicles**: Several, small, 1 to 3µ m; no water-expulsive vesicle. **Crystals**: None; but numerous greenish granules 1.0µ m or less. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; in tide pools, shallow coastal waters. **Distribution**: Atlantic coastal waters, United States, Florida to Massachusetts. **References**: Morphology; ecology; description; Schaeffer (1926).

B(A) Length 20-40µ m; nuclear diameter 4µ m . . . . . *U. elegans*
B(A) Length 13-27µ m; nuclear diameter 4.5µ m . . . . . *U. schaefferi*

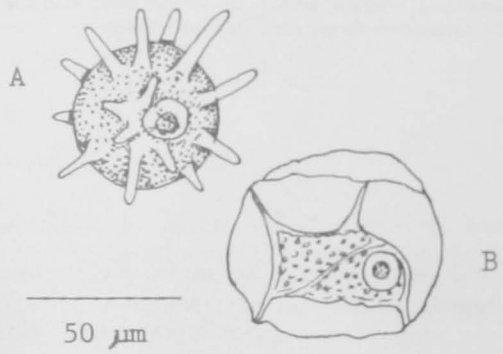


Figure 51.—*Unda elegans*: A—radiate, afloat; B—locomotive form; after Schaeffer (1926).

Unda elegans

Size: Rounded, 20 to 30µ m; radiate, body mass 20µ m diameter, with pseudopods to 40µ m; locomotive, 50 to 60µ m long by 60 to 70µ m wide. **Pseudopods**: Of radiate stage, clear, cylindroid, 6 to 10µ m long, about 1.5µ m diameter, round-tipped; none formed by locomotive stage. **Uroid**: None. **Ectoplasm**: Clear, as peripheral margin, and successive anterior waves in locomotion, one over another. **Endoplasm**: Finely granular. **Nucleus**: Pale, spherical, 4µ m; with central endosome, 1.5µ m diameter. **Vesicles**: None. **Crystals**: None; but many yellowish granules, less than 1.0µ m. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; in tidal pools. **Distribution**: Atlantic coastal waters, United States, known from Cold Spring Harbor, N.Y. **References**: Morphology; ecology; description; Schaeffer (1926).

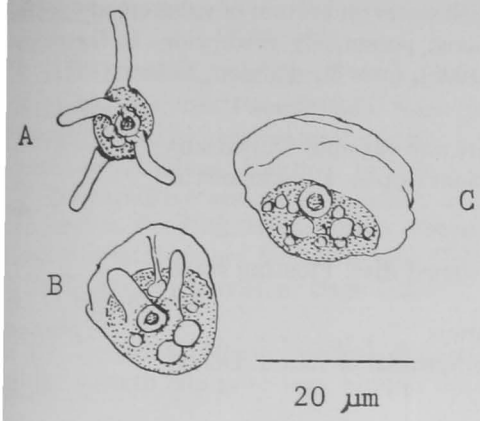


Figure 52.—*Unda schaefferi*: A—radiate, afloat; B—locomotive, with pseudopods; C—locomotive form; after Sawyer (1975b).

Unda schaefferi

Size: Rounded, 8 to 10μm; radiate, body mass 5.5 to 6μm diameter, with pseudopods to 25μm; locomotive, ovate to broadly fan-shaped, 20 to 27μm long by 22 to 29μm wide (mean, 23 by 24μm). **Pseudopods**: Of radiate stage, 8 to 12μm long, cylindroid, 1.5 to 2μm diameter, blunt-tipped; of locomotive stage, broad waves or tongues which flow over anterior margin, appear as temporary ridges, 3 to 5μm wide. **Uroid**: None. **Ectoplasm**: Clear, light-refractile. **Endoplasm**: Granular, as condensed, ovoid mass behind clear, anterior margin; posterior margin often irregular. **Nucleus**: Spherical, 4.5 μm diameter; with central endosome 1.5 to 2 μm diameter (often of two smaller spheres in granular matrix); division by mesomitosis. **Vesicles**: Several, 2 to 4μm diameter; no water-expulsive vesicle. **Crystals**: None; but many tiny granules. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; division; ecology; description; Sawyer (1975b).

39 (*36*) Body usually large, more than 100μm; long, trapezoidal with distinct, parallel, longitudinal, dorsal ridges or folds when in locomotion . . . . . *Thecamoeba*

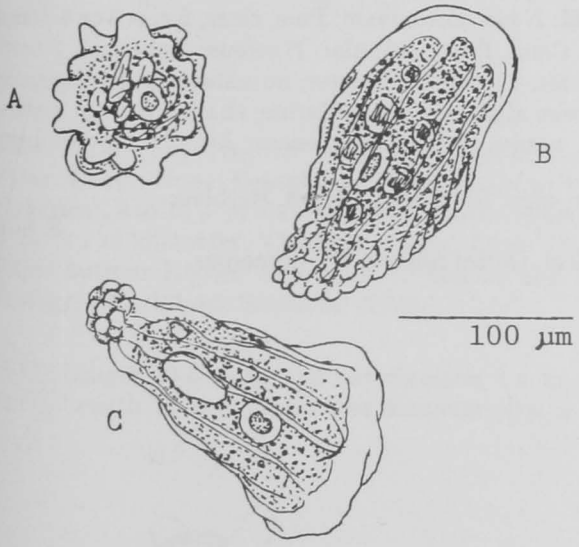


Figure 53.—*Thecamoeba terricola*: A—radiate, at rest; B—usual locomotive form; C—locomotive, cornucopia-shaped; after Gläser (1912).

Thecamoeba terricola (= *verrucosa*)

Size: Rounded, 60 to 150μm; radiate, 100 to 300μm across, more or less cruciform; locomotive, 100 to 350μm long, 50 to 170μm wide (mean, 125 by 65μm). **Pseudopods**: Rarely formed except as blunt bulges. **Uroid**: Temporary, morulate, or wrinkled, rarely with filaments. **Ectoplasm**: Thick, clear, glossy; in locomotion, much wrinkled at rear, more or less parallel ridges over the body; bulges of ectoplasm anteriorly. **Endoplasm**: Granular, grayish to yellowish, with piers of gel underneath ridges. **Nucleus**: Ellipsoid, 40 to 60μm by 20 to 30μm; granules next to membrane; center, clear; no endosome. **Water-expulsive vesicle**: Present in fresh or brackish water, 40 to 60μm diameter; absent in seawater. **Other vesicles**: Some "glycogen spheres," 8 to 12μm diameter; many food vesicles. **Crystals**: Truncated bipyramids, 2 to 4μm long. **Cyst**: Resembles rounded state, wrinkled. **Feeding**: Omnivorous; eats Protozoa, algae, small invertebrates.

Habitat: Fresh water, adaptable to seawater, in moist earth on mosses; brackish water on bottom or submerged vegetation. **Distribution**: Unknown, but reported from scattered marine collections; potentially worldwide. **References**: Morphology; ecology; taxonomy; descriptions; Leidy (1879), Penard (1902, 1905); growth; disivion; Gläser (1912).

39 (*36*) Body usually small, less than 100 μm. Ovate in locomotion, or spatulate and variable. Dorsal surface with more or less distinct, longitudinal ridges or transverse, transient ripples. Pseudopods of radiate stage long and slender, papulate to stubby or absent 40

40 (*39*) Dorsal ridges distinct, more or less permanent. Body a hyaline flattened disc. Floating stage with or without stubby radiating pseudopods . . . . . *Striamoeba* . . . A
A(40) Length 50 μ m or less; nucleus 10 μm. 3-4 dorsal ridges. Herbivorous . . . . . .*S. munda*
A(40) Length 80 μ m or less; nuclear diameter 10 μ m or less. Body ellipsoidal or round. Dorsal ridges numerous or few. Herbivorous or bactivorous . . . . . .B

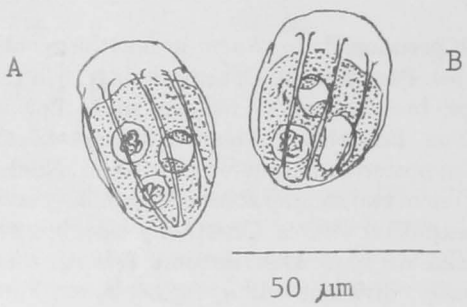


Figure 54.—*Striamoeba munda*: A, B—locomotive forms; after Schaeffer (1926).

Striamoeba munda

Size: Rounded, 30 to 35 μ m; radiate, body mass 25 to 30 μ m, with pseudopods to 40 μ m; locomotive, ovate, 40 to 50 μ m long by 30 to 40 μ m wide. **Pseudopods**: Of radiate stage, short, stubby, about 5 μ m long, 3 to 4 μ m diameter, round-tipped, numerous; no pseudopods formed by locomotive stage. **Uroid**: None. **Ectoplasm**: Pale, clear, forms 3 or 4 dorsal ridges in locomotion and clear, anterolateral margin. **Endoplasm**: Clear, finely granular. **Nucleus**: Spherical, 10 μ m; with endosome as a ring between 2 polar caps. **Vesicles**: Food vesicles, 6 to 8 μ m diameter; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous; on blue-green algae. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Gulf of Mexico, and Atlantic coastal waters, U.S.A. **References**: Morphology; ecology; description; Schaeffer (1926).

B(A) Length 50-80 μ m; nucleus ellipsoidal, 10 μ m long by 5-6 μ m wide. 10-12 dorsal ridges. Herbivorous . . . . . .*S. hilla*
B(A) Length 80 μ m or less; nuclear diameter 10 μ m or less, spherical. Dorsal ridges 3-4 to numerous. Bactivorous C

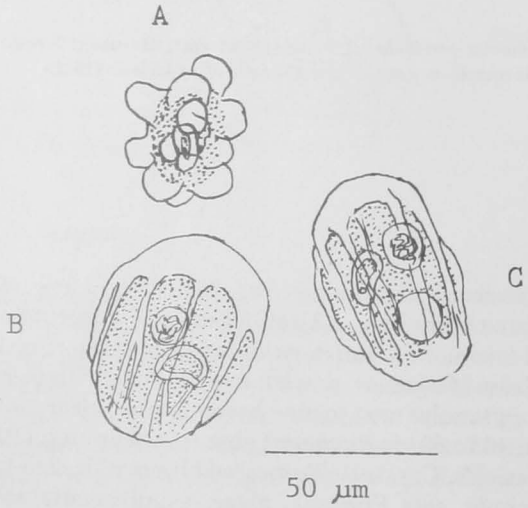


Figure 55.—*Striamoeba hilla*: A—lobate floating form; B, C—locomotive forms; A, B—after Schaeffer (1926); C—after Page (1971b).

Striamoeba hilla

Size: Contracted, irregular, 35 to 45 μ m across; locomotive, ovoid, 50 to 80 μ m long by 30 to 50 μ m wide; afloat, morulate, 30 to 40μm across. **Pseudopods**: None in locomotion, irregular bulges in radiate stage. **Uroid**: None. **Ectoplasm**: Clear, glossy, thick, as anterolateral margin in locomotion, with 10 to 12 linear, dorsal and lateral ridges. **Endoplasm**: Clear, granular. **Nucleus**: Ellipsoid to kidney-shaped, 10μm long by 5 to 6μm wide, with endosome 10 by 4μm. **Vesicles**: Water-expulsive vesicle in brackish water, 10μm diameter; several food vesicles 3 to 8μm. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous; diatoms, other algae. **Habitat**: Shallow coastal waters. **Distribution**: Known from Atlantic coastal waters, United States, Gulf of Mexico to Maine. **References**: Morphology; ecology; description; Schaeffer (1926); ecology; division; Page (1971b).

C(B) Length 60-80μm; nuclear diameter 9μm. Numerous dorsal ridges. Bactivorous . . . . . *S. rugosa*
C(B) Length 50μm or less; nuclear diameter variable. 2-4 dorsal ridges. Bactivorous . . . . . .D

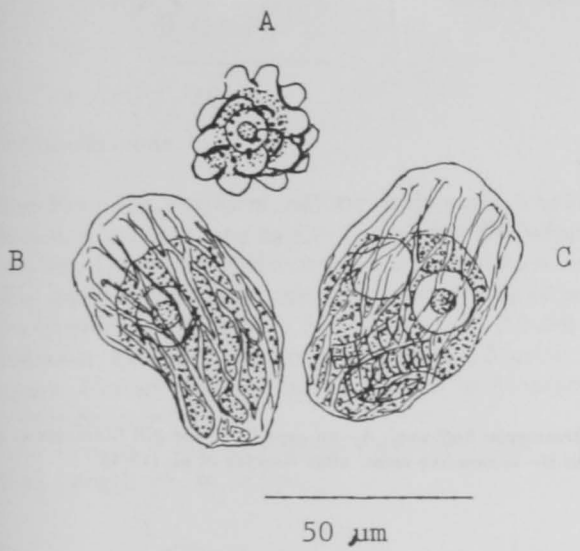


Figure 56.—*Striamoeba rugosa*: A—lobate floating form; B, C—locomotive form; after Schaeffer (1926).

Striamoeba rugosa

Size: Contracted, irregular, 40 to 50μm across; ovate, locomotive, 60 to 80μm long by 35 to 50μm wide. **Pseudopods**: None. **Uroid**: None. **Ectoplasm**: Clear, glossy with many, linear, dorsal ridges. **Endoplasm**: Clear, granular. **Nucleus**: Spherical, 9 to 10 μ m diameter, with central spherical endosome, 6 μ m diameter. **Vesicles**: One or more food vesicles, 3 to 5 μ m diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; coastal waters. **Distribution**: Known from Gulf of Mexico and Atlantic coastal waters, United States. **References**: Morphology; ecology; description; Schaeffer (1926).

D(C) Length 40-50 μ m; nuclear diameter 4 μ m. 3-4 dorsal ridges. Bactivorous . . . . . *S. orbis*
D(C) Length 22-42 μ m; nuclear diameter 10 μ m. 2-3 dorsal ridges. Ectocommensal on fish gills . . . *S. hoffmani*

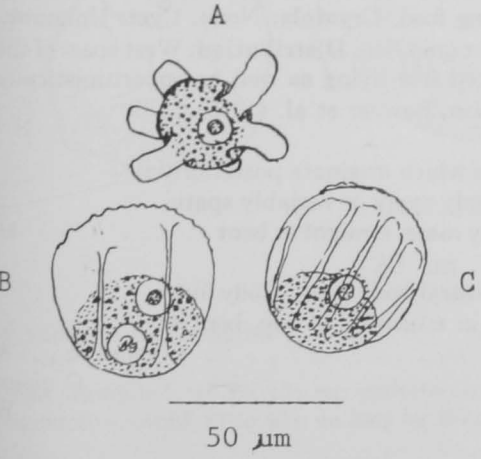


Figure 57.—*Striamoeba orbis*: A—radiate, afloat; B, C—locomotive forms; A, C—after Page (1971b); B—after Schaeffer (1926).

Striamoeba orbis

Size: Rounded, 10 to 12 μm; radiate, body mass 7 μm across, with pseudopods to 18 μm across; locomotive, ovoid, 40 to 50 μm long by 40 to 50 μm wide. **Pseudopods**: Of radiate stage, several, blunt, digitate, 3 to 6 μm long, 2 to 3 μm diameter; none in locomotion. **Uroid**: None. **Ectoplasm**: Clear, glossy, as anterior three-fifths of locomotive body in locomotion with 3 or 4 longitudinal ridges; forms digitate pseudopods of radiate stage. **Endoplasm**: Clear, granular, as posterior two-fifths of locomotive body. **Nucleus**: Spherical, 4 μm diameter with round, central endosome, 2 μm. **Vesicles**: Small, 2 to 3 μm, as food vesicles; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; coastal waters. **Distribution**: Known from Atlantic coast, United States, Florida to Maine. **References**: Morphology; description; Schaeffer (1926); ecology; division; Page (1971b).

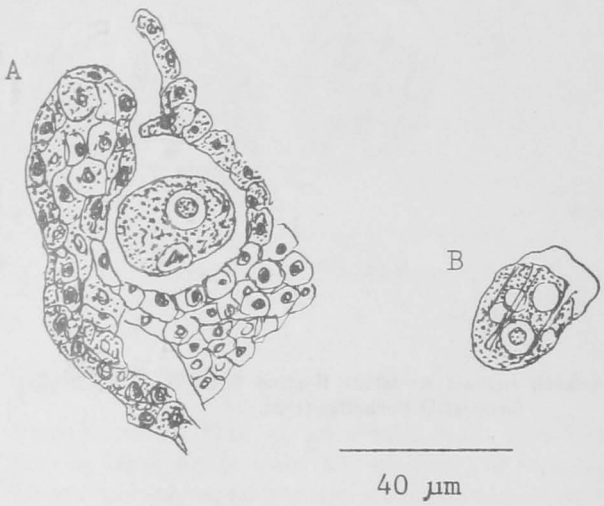


Figure 58.—*Striamoeba hoffmani*: A—an amoeba in the gill filaments of a fish; B—locomotive form; after Sawyer et al. (1975).

Striamoeba hoffmani

Size: Ovoid, 21.6 to 40.8 μm long (mean, 31.0 μm) by 16.8 to 28.0 μm wide (mean, 23.1 μm) when fixed and stained. **Pseudopods**: Noneruptive, clear, anterior bulges in slow locomotion. **Uroid**: None. **Ectoplasm**: Clear, as anterolateral margin and several longitudinal ridges or folds. **Endoplasm**: Granular. **Nucleus**: Spherical, 10 μm diameter with endosome, 6 μm diameter; division, mesomitotic. **Vesicles**: Several, containing food. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous, perhaps cytivorous. **Habitat**: On gills of fingerling salmonid fish. **Distribution**: West coast of the United States, Oregon and Washington, hatcheries in Michigan. Considered free-living as well as opportunistically parasitic, and perhaps worldwide. **References**: Description; ecology; division; Sawyer et al. (1975).

40 (*39*) Dorsal ridges absent, or present as transient single or double ridges which originate posteriorly and flow anteriorly to disappear upon reaching anterior margin. Body ovate or variably spatulate. Pseudopods of floating form numerous, longer than central body mass, straight or bent 41

41 (*40*) Pseudopods of floating form as long as or longer than diameter of central body mass. Body form changeable in locomotion. Radiating pseudopods of floating form in multiples of two, bent or kinked along axis . . . . . *Clydonella* . . . A
A(41) Length 8-12 μm; nuclear diameter 2 μm . . . . . *C. vivax*
A(41) Length up to 40 μm . . . . . .B

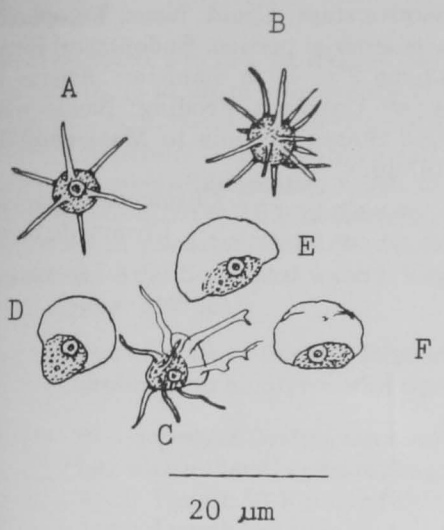


Figure 59.—*Clydonella vivax*: A, B—floating forms; C—beginning locomotion after floating; D, E, F—locomotive forms; A, D, E—after Schaeffer (1926); B, C, F—after Sawyer (1975c).

Clydonella vivax

Size: Rounded, 6 to 8 µm; radiate, body mass, 5 to 6 µm, with pseudopods to 30 µm across; locomotive, long ovoid to fan-shaped, 8 to 12 µm long by 8 to 12 µm wide. **Pseudopods**: Of radiate stage, clear, straight, tapered; round-tipped, 6 to 10 µm long, 1.0 µm basal diameter, less than 0.5 µm at tips; no pseudopods in locomotion. **Uroid**: None. **Ectoplasm**: As clear anterolateral part, one-half to two-thirds of body in locomotion; with lateral folds along body mass. **Endoplasm**: Finely granular. **Nucleus**: Spherical, pale, 2.0 µm diameter, with central endosome, 1.0 µm. **Vesicles**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Atlantic coastal waters, United States, Gulf of Mexico to Massachusetts. **References**: Morphology; ecology; description; Schaeffer (1926); Sawyer (1975c).

B(A) Length 21-40 µm; nuclear diameter 4.5 µm . . . . . *C. sindermanni*
B(A) Length 20 µm or less C

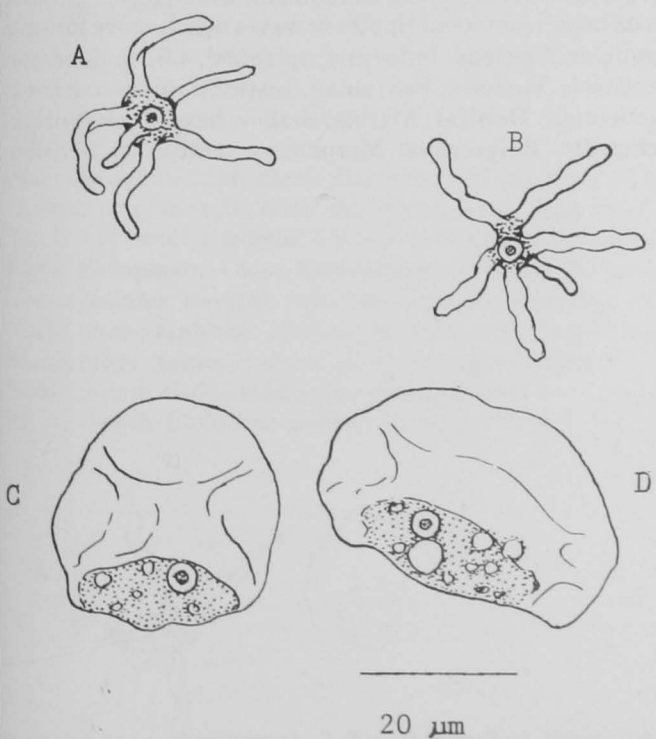


Figure 60.—*Clydonella sindermanni*: A, B—floating forms; C, D—locomotive forms; after Sawyer (1975b).

Clydonella sindermanni

Size: Rounded, 10 to 13 µm; radiate, irregular body mass about 5 µm across, with pseudopods to 50 µm across; locomotive, ovoid, 21 to 40 µm long by 18 to 37 µm wide (mean, 28 by 27 µm). **Pseudopods**: Of radiate stage, irregularly

twisted, cylindroid, 3 to 5μm diameter, bluntly round-tipped; none in locomotive stage. **Uroid**: None. **Ectoplasm**: Clear, anterior two-thirds of body, formed as waves, ripples, or forked waves over anterior portion. **Endoplasm**: Finely granular. **Nucleus**: Distinct, spherical, 4.5μm diameter, with central endosome 3 to 4μm diameter; division by mesomitosis. **Vesicles**: Few, small, 2 to 3μm diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; culturing; ecology; division; description; Sawyer (1975b).

C(B) Length 14-19μm; nuclear diameter 4.5μm . . . . . *Clydonella rosenfieldi*

C(B) Length 14-20μm; nuclear diameter 3-3.5μm . . . . . *Clydonella wardi*

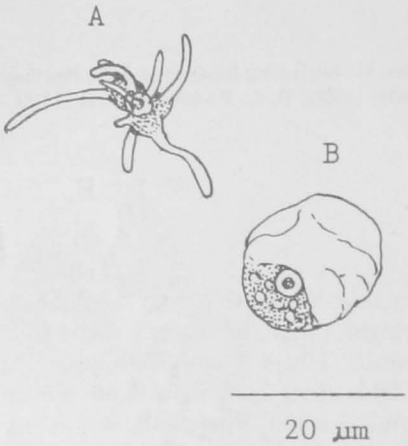


Figure 61.—*Clydonella rosenfieldi*: A—floating form; B—locomotive form; after Sawyer (1975b).

Clydonella rosenfieldi

Size: Rounded, 7 to 8 μm; radiate stage, body mass 5 to 6 μm, with pseudopods to 40 μm diameter; locomotive, 14 to 19 μm long by 14 to 19μm wide (mean, 17 by 16μm). **Pseudopods**: Of radiate stage, 10 to 16μm long, cylindroid to slightly tapered, round-tipped, 1.5 to 2μm diameter; none in locomotive stage. **Uroid**: None. **Ectoplasm**: Clear, forms anterior area as wide as two-thirds the length of the body in locomotion, as broken or forked ripples or waves which move forward over the clear anterior toward the front. **Endoplasm**: Finely granular. **Nucleus**: Indistinct, spherical, 4.5μm diameter, with central endosome 2.0 to 2.5μm diameter; division by mesomitosis. **Vesicles**: Few, small, 1.0 to 2.0μm; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; culturing; division; description; Sawyer (1975b).

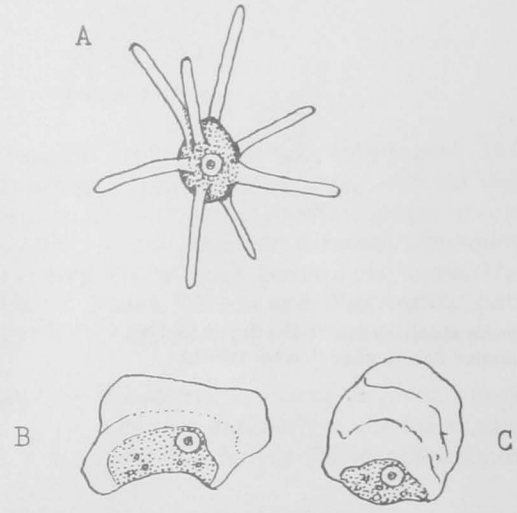


Figure 62.—*Clydonella wardi*: A—floating form; B, C—locomotive forms; after Sawyer (1975b).

Clydonella wardi

Size: Rounded, 8 to 10 μ m; radiate, body mass 4 to 5 μ m diameter, with pseudopods to 30 μ m across; locomotive, 14 to 20 μm long by 13 to 19μ m wide (mean, 18 by 16μ m). **Pseudopods**: Of radiate stage, clear, cylindroid, slender, 20 to 25μ m long, 1.5μm diameter; locomotive stage, no pseudopods formed. **Uroid**: None. **Ectoplasm**: Clear, as anterior two-thirds to three-fourths of body length, formed as advancing ripples, which may fork, or shallow waves which disappear at the anterior margin. **Endoplasm**: Finely granular, as posterior one-third to one-fourth of body mass. **Nucleus**: Clear, distinct, spherical, 3.0 to 3.5 μ m diameter, with central endosome 2.5 μ m diameter; division by mesomitosis. **Vesicles**: Few, 0.5 to 3 μ m diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Atlantic coastal waters, Virginia to Massachusetts. **References**: Morphology; culturing; division; description; Sawyer (1975b).

41 (*40*) Pseudopods of floating form much longer than diameter of central, body mass, or short and stubby with blunt, rounded tips 42

42 (*41*) Pseudopods of floating form long, thin, and stellate; may coil like a helix near tip. Body triangulate with either dimension the greater of the two . . . . . *Vannella* . . . A
A(42) Length 50-75μm; nuclear diameter 15μm . . . . . *V. crassa*
A(42) Length less than 50μm . . . . . B

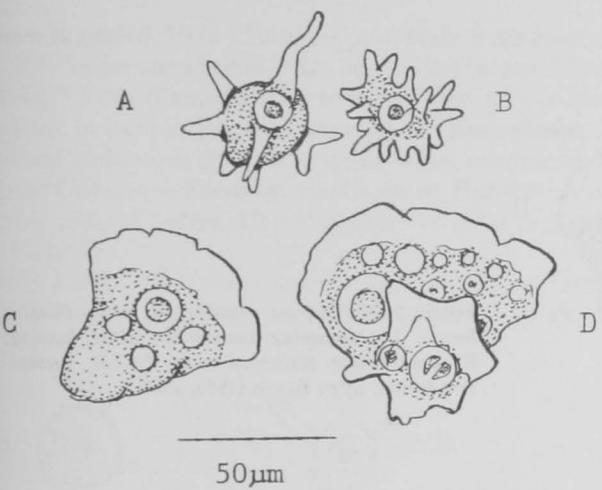


Figure 63.—*Vannella crassa*: A, B—floating forms; C, D—locomotive forms; after Schaeffer (1926).

Vannella crassa

Size: Rounded, 20 to 30μm diameter; radiate, body 15 to 20μm, with pseudopods to 60μm; locomotive, with clear, incised anterior margin, 50 to 75μ m long, 50 to 75μ m wide. **Pseudopods**: Of radiate stage, bluntly conical, 5 to 18μm long, 4 to 5 μ m basal diameter, 2 to 4 μ m diameter at tips; of locomotive stage, few, from body surface, short, blunt. **Uroid**: None. **Ectoplasm**: Clear. **Endoplasm**: Granular. **Nucleus**: Spherical, 15μ m diameter, with central spherical endosome, 6μm. **Vesicles**: Several, pale, 2 to 5μ m diameter; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; in tide pools. **Distribution**: Known from Gulf of Mexico, Florida, U.S.A. **References**: Morphology; ecology; description; Schaeffer (1926).

B(A) Length 15-25μm; nuclear diameter 4-6μm . . . . . *V. mira*
B(A) Length 13-20μm; nuclear diameter 3μm . . . . . *V. sensilis*

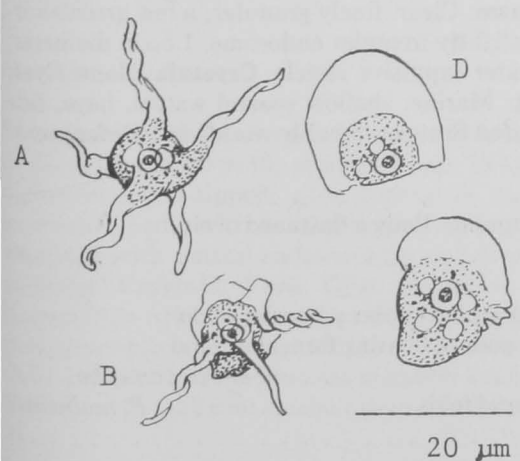


Figure 64.—*Vannella mira*: A—radiate, afloat; B—beginning locomotion after floating; C, D—locomotive forms; A, B, D—after Bovee (1950); C—after Schaeffer (1926).

Vannella mira

Size: Rounded, 8 to 10 μ m; radiate, body irregularly round, 5 to 6 μ m, with pseudopods to 30 μ m diameter; locomotive, fan-shaped, 15 to 25 μ m long by 15 to 25 μ m wide. **Pseudopods**: Of radiate stage, 12 to 20 μ m long, clear, conical, bases partly granular; of locomotive stage, conical, from body, rarely formed, broad clear anterior margin forms none. **Uroid**: None. **Ectoplasm**: Clear. **Endoplasm**: Finely granular. **Nucleus**: Spherical, 4 to 6 μm diameter, with central endosome, 2 to 3 μ m diameter; division, mitotic. **Water-expulsive vesicle**: None in seawater; 3 to 6 μ m in brackish or fresh water; no other vesicles. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; coastal waters, tide pools, on algae. **Distribution**: Known from Atlantic coast, United States, Florida to Maine; Pacific Coast, southern California; coral reefs, Madagascar. **References**: Morphology; ecology; distribution; description; Schaeffer (1926), Page (1971a).

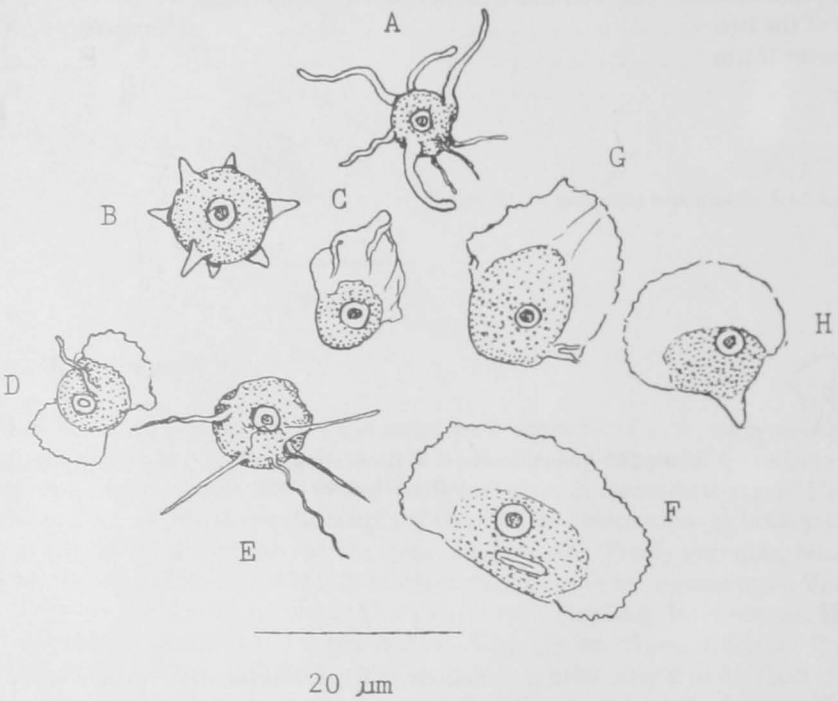


Figure 65.—*Vannella sensilis*: A, B, C—floating forms; D—beginning locomotion after floating; E—semiradiate, disturbed stage; F, G, H—locomotive forms; after Bovee (1950, 1953).

Vannella sensilis

Size: Rounded, 8 to 10μm; afloat, wrinkled, 10 to 15μm across, or radiate, body mass 8 to 9μm, with pseudopods to 18 μ m across; locomotive, fan-shaped, 13 to 20 μ m long by 15 to 24 μ m wide. **Pseudopods**: Of radiate stage, 3 to 5 μ m long, basal diameters 2 to 2.5μm, tapered to round tips about 0.8μm diameter; no pseudopods formed in locomotion, but edge of advancing clear margin often finely dentate. **Uroid**: None. **Ectoplasm**: Clear, smooth, as anterolateral, clear margin and as radiate pseudopods; wrinkled in irregular floating stages. **Endoplasm**: Clear, finely granular; a few greenish irregular granules 0.8 to 1.5μm. **Nucleus**: Spherical, 3μm, with round or slightly irregular endosome, 1.5μm diameter; division, mesomitotic. **Vesicles**: Food vesicles, 2 to 5μm diameter; no water-expulsive vesicle. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous; on small algae and bacteria. **Habitat**: Marine; shallow coastal waters, bays, tide pools. **Distribution**: Known from Atlantic and Pacific coastal waters, United States, probably worldwide. **References**: Morphology; ecology; description; Bovee (1950, 1953), Sawyer (1975c).

42 (*41*) Pseudopods of floating form short and stubby, or absent; few in number. Body a flattened ovoid, teardrop shaped, or lingulate 43

43 (*42*) Body ovoid or disc-shaped with broad, smooth, anterior margin and granular posterior endoplasm. Transient, lateral ridges or folds present or absent. Pseudopods of floating form short and stubby . . . . . *Platyamoeba* . . . A
A(43) Length 19-35μm; nuclear diameter 3.5-5μm. Transient lateral folds . . . . . *P. mainensis*
A(43) Length less than 20μm; nuclear diameter 2-4.5μm . . . . . B

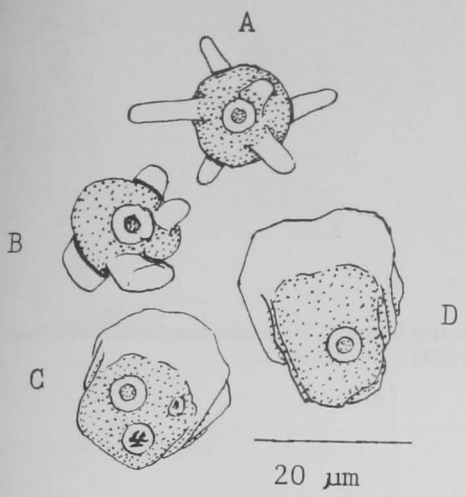


Figure 66.—*Platyamoeba mainensis*: A—radiate, afloat; B—lobed radiate form; C, D—locomotive forms; after Page (1971b).

Platyamoeba mainensis

Size: Rounded, 10 to 12 μm; radiate, body mass 8 μm across, with pseudopods to 22 μm across; locomotive, broadly ovate a little longer than broad, 19 to 35 μm long (mean, 25 μm). **Pseudopods**: Of radiate stage, bluntly digitate, 5 to 7 μm long, about 1.5 μm diameter with rounded tips; no pseudopods in locomotion. **Uroid**: None. **Ectoplasm**: Clear, as anterior portion in locomotion, and pseudopods. **Endoplasm**: Faintly granular. **Nucleus**: Spherical, 3.5 to 5 μm diameter; with central endosome, 2.75 to 3 μm; division, mitotic without polar caps. **Vesicles**: Few, with food, 3 μm. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays and estuaries. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Maine. **References**: Morphology; ecology; description; division; Page (1971b).

3(A) Length 12-15 μm; nuclear diameter 4.5 μm. Transient transverse ripples or waves . . . . . *P. douvresi*
3(A) Length less than 15 μm; ridges lateral or absent C

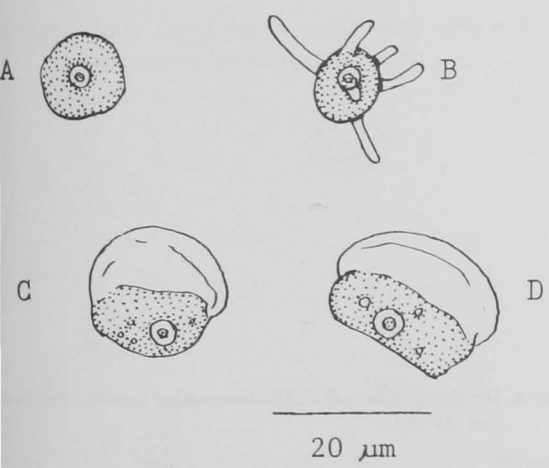


Figure 67.—*Platyamoeba douvresi*: A—rounded, at rest; B—radiate, afloat; C, D—locomotive forms; after Sawyer (1975b).

Platyamoeba douvresi

Size: Contracted, 7 to 8 μm; radiate, body mass 8 to 9 μm diameter, with pseudopods, 25 to 27 μm across; locomotive, 12 to 15 μm long by 10 to 16 μm wide (mean, 13 by 12 μm). **Pseudopods**: Of radiate stage, cylindroid, 7 to 8 μm long, 1.5 μm diameter, round-tipped; none formed in locomotion. **Uroid**: None. **Ectoplasm**: Pale, glossy, as anterior part of locomotive body, with moving transverse waves. **Endoplasm**: Faintly granular. **Nucleus**: Indistinct, spherical, 4.5 μm diameter, with central endosome 2.0 to 2.5 μm diameter; division by mesomitosis. **Vesicles**: Few, small, about 1.0 μm diameter. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; ecology; division; description; Sawyer (1975b).

C(B) Length 11-12 μm; nuclear diameter 3-3.5 μm . . . . . *P. weinsteini*
C(B) Length 7-13 μm; nuclear diameter 2 μm; ridges absent . . . . . D

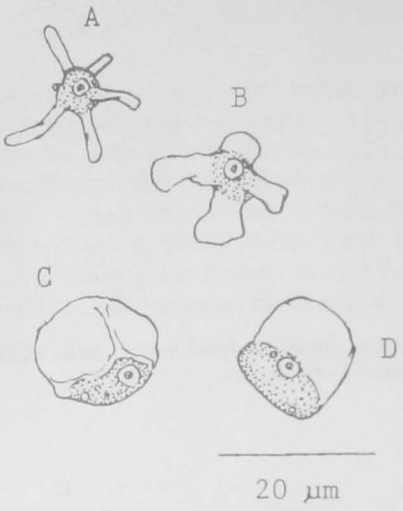


Figure 68.—*Platyamoeba weinsteini*: A, B—floating forms; C, D—locomotive forms; after Sawyer (1975b).

Platyamoeba weinsteini

Size: Contracted, 7 to 8 µm; radiate, body mass 4 to 5 µm across, with pseudopods to 22 µm across; locomotive, ovoid, 11 to 12µm long by 12 to 16µm wide (mean, 12 by 13µm). **Pseudopods**: Of radiate stage, 7 to 8µm long, cylindroid, 1.75µm diameter with rounded tips; no pseudopods in locomotion; blunt tongues in descent to substrate. **Uroid**: None. **Ectoplasm**: Clear, refractile in pseudopods and as anterior half of body with temporary, distinct, transient, lateral folds. **Endoplasm**: Faintly granular. **Nucleus**: Distinct, spherical, 3.0 to 3.5µm, with spherical or elliptical endosome slightly smaller; division by mesomitosis. **Vesicles**: Rare, small. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; ecology; division; description; Sawyer (1975b).

D(C) Length 8-13µm; nuclear diameter 2µm; nucleus indistinct . . . . . *P. murchelanoi*
D(C) Length 7-12µm; nuclear diameter 2µm; nucleus distinct . . . . . *P. langae*

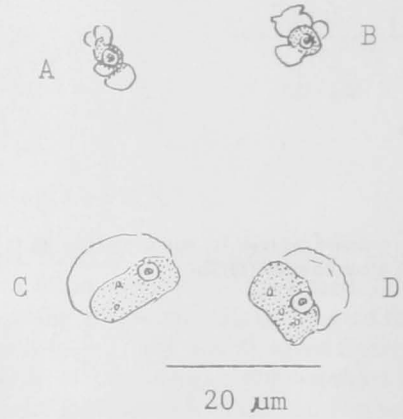


Figure 69.—*Platyamoeba murchelanoi*: A, B—floating forms; C, D—locomotive forms; after Sawyer (1975b).

Platyamoeba murchelanoi

Size: Contracted, 5 to 6µm diameter; afloat, irregular, crumpled, 5 to 6µm across; locomotive, ovoid, 8 to 13µm long by 6 to 11µm wide (mean, 11 by 9µm). **Pseudopods**: Seldom formed, as irregular short, blunt lobes. **Uroid**: None. **Ectoplasm**: Pale, clear as anterior one-half of the locomotive body, with faint transient, lateral ridges. **Endoplasm**: Faintly granular. **Nucleus**: Indistinct, spherical, 2.0µm diameter, with central endosome 1.0 to 1.5µm diameter; division by mesomitosis. **Vesicles**: Few, tiny when present. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Atlantic coastal waters, Virginia to Massachusetts. **References**: Morphology; ecology; division; description; Sawyer (1975b).

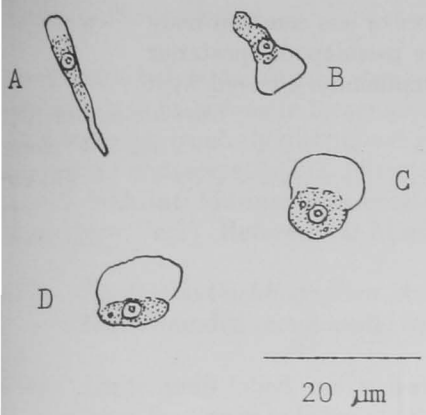


Figure 70.—*Platyamoeba langae*: A—"tent-peg" floating form; B—beginning locomotion after floating; C, D—locomotive forms; after Sawyer (1975b).

Platyamoeba langae

Size: Rounded, 3.5 to 4.5µm; afloat, awl-shaped or twisted, 18 to 23µm long, 2.5µm at blunt end, tapered to 1.5µm at arrow end; locomotive, ovoid, 7 to 12µm long by 5 to 10µm wide (mean, 9 by 8µm). **Pseudopods**: Formed in descent rom floating as blunt bulges; none formed in locomotion. **Uroid**: None. **Ectoplasm**: Clear, pale, as anterior part of body n locomotion, rarely with delicate transient lateral folds. **Endoplasm**: Clear, faintly granular. **Nucleus**: Spherical, 2µm iameter, with central endosome, 1.0 to 1.5µm diameter, indistinct; division by mesomitosis. **Vesicles**: Few, small, bout 1.0µm. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow coastal waters. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; cology; division; description; Sawyer (1975b).

3 (*42*) Body dimensions about equal, or length 2 or 3 times longer than width in locomotion; ridges or folds absent. Floating form irregular without radiating pseudopods 44

4 (*43*) Length and width equal; radiate floating stage absent. Ridges, folds, or ripples absent. No marine species known . . . . . *Discamoeba*

4 (*43*) Body 2 or 3 times longer than wide in locomotion; ridges, folds, or ripples absent. Floating form without radiating pseudopods . . . . . *Lingulamoeba leei*

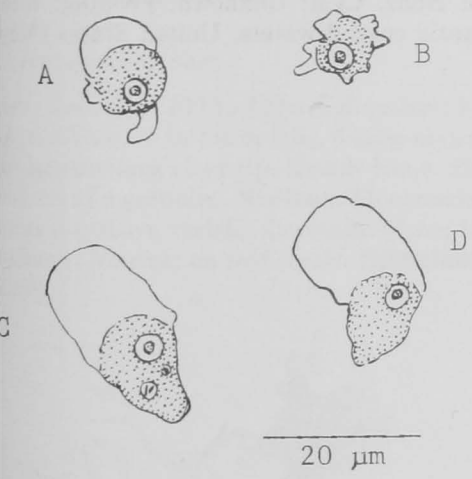


Figure 71.—*Lingulamoeba leei*: A—beginning locomotion; B—radiate, afloat; C, D—locomotive forms; after Sawyer (1975b).

Lingulamoeba leei

Size: Contracted, 7 to 8µm; afloat, irregular, wrinkled 8 to 9µm across; locomotive, lingulate, 16 to 23µm long by 12.5 µm wide (mean, 20 by 14.5µm). **Pseudopods**: Few, when disturbed, cylindroid, often bent, 6 to 8µm long, 1.5µm diameter, round-tipped, clear; none formed in locomotion. **Uroid**: Temporary, tubelike for expelling bacteria. **Ectoplasm**: Clear, pale, oblong, as anterior half of body. **Endoplasm**: Granular, as trailing, triangular half of locomotive body. **Nucleus**: Indistinct, spherical, 3.5µm, with central endosome, 2.5µm diameter; division by mesomitosis. **Vesicles**: Few; small, food vesicles contain bacteria. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Known from Atlantic coastal waters, United States, Virginia to Massachusetts. **References**: Morphology; ecology; division; description; Sawyer (1975b).

45 (*1*) Body discoid to broadly ovoid with more or less rigid plasmalemma; more or less constant body form in locomotion. Anterior margin clear, smooth or with short, fine pseudopods; posterior margin smooth or with short trailing uroidal filaments. Hyaline plasmalemma covered with small granules or scales produced from Golgi complex . . . . . *Cochliopodium* . . . A

A(45) Body diameter 40μm; nuclear diameter 6.5-7μm . . . . . *C. clarum*

A(45) Body diameter 80μm; nuclear diameter 5μm . . . . . *C. gulosum*

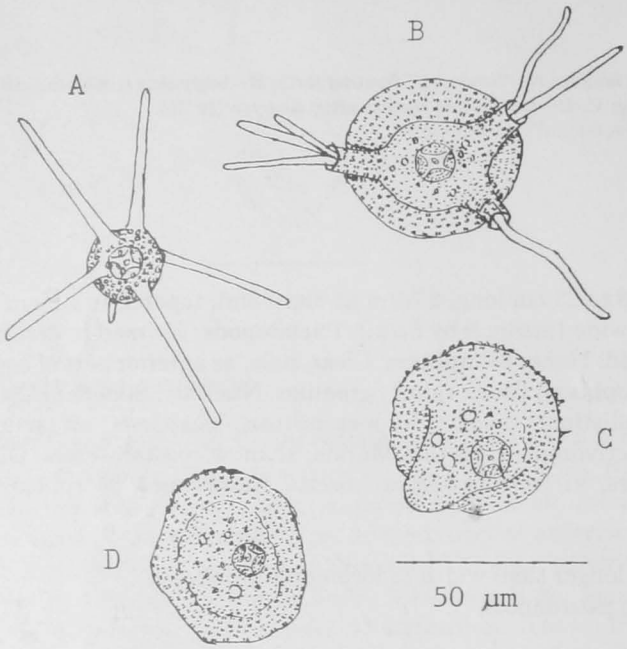


Figure 72.—***Cochliopodium clarum***: A—radiate, afloat; B—radiate, on substrate; C, D—locomotive forms; after Schaeffer (1926).**

Cochliopodium clarum

Size: Contracted, 35 to 40μm across; afloat, about 30μm; locomotive, circular to slightly ovoid, 40μm across, with central mass, 25μm. **Pseudopods**: Few, short, clear, digitate, 2 to 3μm long at edge of clear, peripheral skirt in locomotion. **Uroid**: None. **Ectoplasm**: Clear, glossy, as peripheral skirt 10 to 12μm wide, with numerous, regularly distributed granules about 1.5 to 2μm. **Endoplasm**: Clear; few granules. **Nucleus**: Spherical, 6.5 to 7.0μm, with central endosome, 5 μm diameter. **Vesicles**: Several, nonexpulsive; no food masses. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; bays, harbors. **Distribution**: Known from Atlantic coastal waters, United States (New York). **References**: Morphology; ecology; description; Schaeffer (1926).

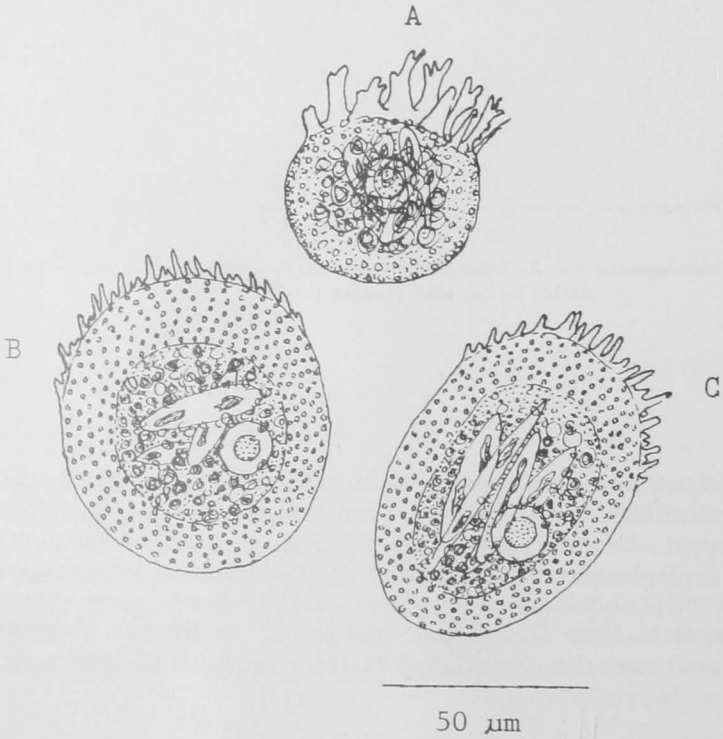


Figure 73.—***Cochliopodium gulosum***: A—medusa-like floating form; B, C—locomotive forms; after Schaeffer (1926).**

Cochliopodium gulosum

Size: Contracted, 60 to 70 μm; locomotive, circular to slightly ovoid, 80 μm across; central mass, 50 μm. **Pseudopods**: At periphery, 3 to 5 μm long in locomotion. **Uroid**: None. **Ectoplasm**: Clear, glossy, as peripheral skirt about 15 μm wide, with numerous, regularly distributed granules, 1.5 to 2.0 μm. **Endoplasm**: Clear, granular. **Nucleus**: Spherical, 15 μm, with central endosome, 10 μm diameter. **Vesicles**: None. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Herbivorous; on diatoms. **Habitat**: Marine; bays, coastal waters, on eel grass. **Distribution**: Known from Atlantic coastal waters, United States (New York). **References**: Morphology; ecology; description; Schaeffer (1926).

5 (*1*) Similar to *Cochliopodium*. Anterior margin smooth and rounded. Posterior margin with several blunt rounded pseudopods. No marine species known . . . . . *Amphizonella*

6 (*1*) Large, multilobed; uninucleate. Contracted when attached to substrate, branched and radiate when feeding or in locomotion; numerous branched or forked pseudopods with round tips . *Stereomyxa* . . . A
A(46) Pseudopods lobose with round tips; mononucleate . . . . . .*S. angulosa*
A(46) Pseudopods tapered and branched; sometimes binucleate, otherwise mononucleate . . . . . *S. ramosa*

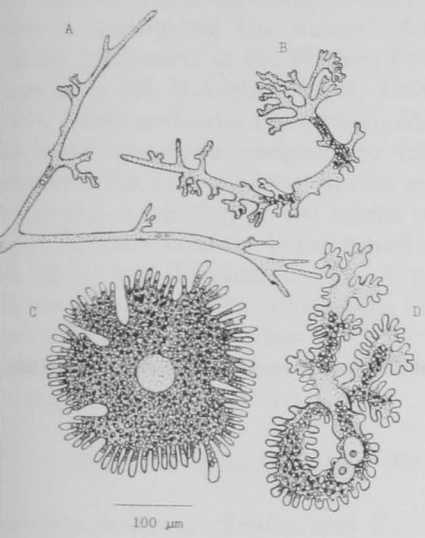


Figure 74.—*Stereomyxa angulosa*: A, B—extended, active, contracted; C, D—at rest; after Grell (1966).

Stereomyxa angulosa

Size: Rounded, 100 to 120 μm diameter; locomotive, ramose, 150 to 300 μm long or wide. **Pseudopods**: Of contracted state, lobose, 25 to 45 μm long, 6 to 8 μm diameter, with clear, rounded tip, 10 to 15 μm long; of locomotive stage, similar, but usually lack clear tip. **Uroid**: None. **Ectoplasm**: Clear, thin except at tips of pseudopods. **Endoplasm**: Clear, with vesicles and granules. **Nucleus**: Mononucleate; not otherwise described. **Vesicles**: Many, small, 2 to 6 μm diameter; no water-expulsive vesicle. **Crystals**: None; but many granules about 1.0 μm. **Cyst**: Unknown. **Feeding**: Not described. **Habitat**: Marine; on reef corals. **Distribution**: Reported from coral reefs, Madagascar. **References**: Description; Grell (1966).

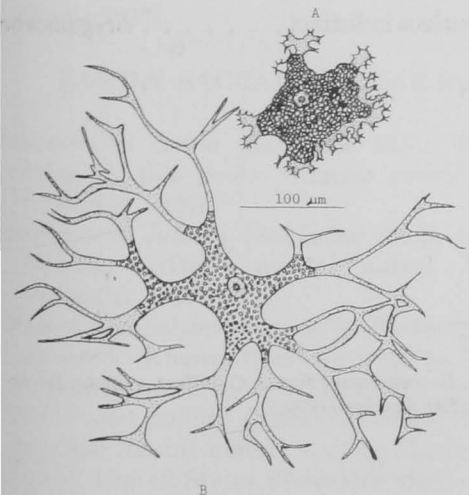


Figure 75.—*Stereomyxa ramosa*: A—contracted; B—extended; after Grell (1966).

Stereomyxa ramosa

Size: Contracted 250 to 300μm wide; locomotive, ramose, body mass 50 to 100μm across, with pseudopods up to 1,000 μm long. **Pseudopods**: Clear, tapered, branched, sometimes fused, up to 150μm long, 10 to 12μm at bases, end branches 10 to 50μm long, 1 to 4μm at bases, tips rounded to pointed. **Uroid**: None. **Ectoplasm**: Thin, clear, with attached debris. **Endoplasm**: Clear, vesicular and granular. **Nucleus**: Spherical, 12μm diameter, with central endosome, 4 m diameter, sometimes binucleate. **Vesicles**: Many, small, 2 to 8μm diameter; no water-expulsive vesicle. **Crystals**: None; but many granules. **Cyst**: Unknown. **Feeding**: Not described. **Habitat**: Marine; on coral reefs. **Distribution**: Reported from reefs on Madagascar. **References**: Morphology; description; Grell (1966).

46 (*1*) Large, multinucleate with compact network-like plasmodial form; or minute, mononucleate, and forked or leaflike body form 47

47 (*46*) Very large, multinucleate; not leaflike or forked . . . . . *Corallomyxa*

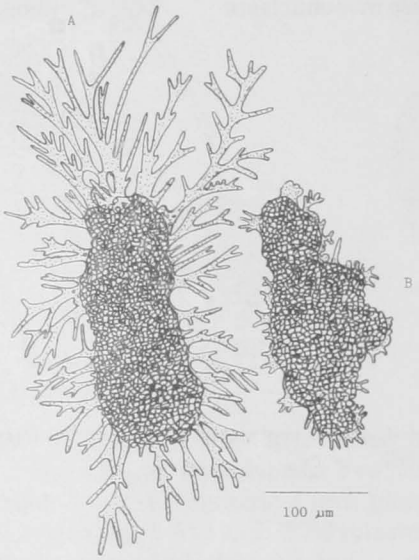


Figure 76.—*Corallomyxa mutabilis*: A—extended, feeding; B—contracted; after Grell (1966).

Corallomyxa mutabilis

Size: Contracted, irregular, 200 to 300μ m across; locomotive, ramose, 2,000 to 3,000μ m across, body mass more or less cruciform. **Pseudopods**: Ramose, digitate, sometimes fused, 10 to 300μ m long, 5 to 20μ m wide at bases, rounded tips of terminal branches, 2 to 4μm. **Uroid**: None. **Ectoplasm**: Clear, gelatinous, thin, with attached diatoms and debris. **Endoplasm**: Clear, with vesicles and granules. **Nucleus**: Multinucleate (20 or more); each spherical, 10 to 12μm diameter, with central endosome, 3 to 4μm diameter. **Vesicles**: Many, small, 2 to 8μm diameter; large food vesicles; no water-expulsive vesicle. **Crystals**: None; but many granules. **Cyst**: Unknown. **Feeding**: Not described. **Habitat**: Marine; coral reefs. **Distribution**: Reported from coral reefs, Madagascar. **References**: Morphology; description; Grell (1966).

47 (*46*) Minute, leaflike or forked, or stick-like; locomotion slow. Mononucleate, nucleus indistinct . . . . . *Stygamoeba*

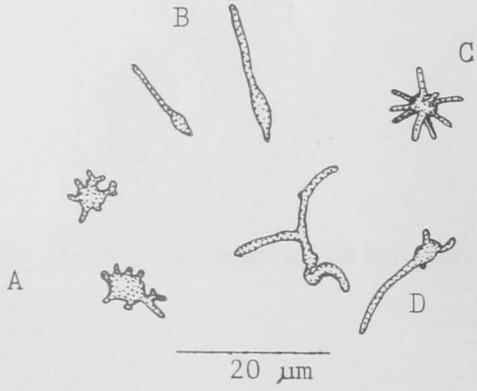


Figure 77.—*Stygamoeba polymorpha*: A, B—contracted forms; C—afloat, radiate; D—active forms; after Sawyer (1975a).

Stygamoeba polymorpha

Size: Contracted 10 to 15μm across; radiate, body mass 8μm, with pseudopods, to 40μm across; locomotive, multiform, ramose 13 to 17μm across, or elongate to 30μm by 3 to 5μ wide. **Pseudopods**: Of contracted state, short, blunt, clear, 2 to 10μm long, 1 to 3μm wide, tips rounded; of radiate stage, 5 to 15μm long, 2 to 4μm diameter, somewhat twisted or bent; of locomotive stage, continuous with elongate body, which flows into them. **Uroid**: Absent. **Ectoplasm**: Clear, pale, glossy. **Endoplasm**: Clear, scarcely distinguishable from ectoplasm. **Nucleus**: Indistinct, round to ovoid, 1.5 to 2.0μm diameter; no endosome visible. **Vesicles**: None. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Known from Atlantic coast, United States, from Virginia to Massachusetts. **References**: Morphology; description; Sawyer (1975a).

ANNOTATED SYSTEMATIC LIST

This list is arranged with reference to families, genera, and species of amoebae. Higher categories are a matter of dispute concerning the names and arrangements of classes and orders in the Phylum Protozoa, Subphylum Sarcodina (cf. Honigberg et al. 1964; Jahn and Bovee 1965; Bovee and Jahn 1965, 1966). All the amoebae here included would be assigned to the lobose amoebae whatever the names of the ordinal and class ranks may be in one or another of the recent taxonomic schemes (e.g., Subclass Lobosia, Order Amoebida in Honigberg et al. 1964; but Subclass Cyclia, Superorder Lobida in Bovee and Jahn 1965, 1966); and Class Lobosia, Suborder Gymnamoebia (Page 1976). Notes on habitat, distribution, and general occurrence are given. References to important works are cited.

FAMILY AMOEBIDAE (Diesing 1838)

Amoeba lescherae Taylor and Hayes 1944. Found in brackish tide pools, British Isles; probably widely distributed (Taylor and Hayes 1944).

FAMILY PELOMYXIDAE (Poche 1931)

Pelomyxa ostendensis Kufferath 1952. Reported from Atlantic coastal waters, northern Europe; not otherwise known (Kufferath 1952).

Trichamoeba schaefferi Radir 1927. Reported from Monterey Bay, Calif.; probably more widely distributed (Radir 1927).

FAMILY SACCAMOEBIDAE Bovee 1972

Saccamoeba gumia (Schaeffer 1926). Herbivorous on algae, in tide pools, Atlantic coast, United States (Schaeffer 1926).

Saccamoeba fulvum (Schaeffer 1926). Herbivorous on diatoms, Atlantic coastal waters, United States (Schaeffer 1926).

Rhizamoeba polyura Page 1972. Bactivorous, in shallow estuaries. Known from Virginia to Massachusetts, Atlantic coastal waters, United States (Page 1972a).

Rhizamoeba pallida (Schaeffer 1926). Bactivorous, in shallow coastal waters, Gulf of Mexico and Atlantic coast, United States (Schaeffer 1926).

Rhizamoeba sphaerarum (Schaeffer 1926). Herbivorous on small algae, bacteria. Known from shallow coastal waters, Gulf of Mexico and Atlantic coast, United States (Schaeffer 1926).

FAMILY HARTMANNELLIDAE Volkonsky 1931

Hartmannella tahitiensis Cheng 1970. Bactivorous, cytivorous, possibly a commensal in oysters, *Crassostrea commercialis*. Reported from commercially developed oyster beds in Tahiti; perhaps widely distributed (Cheng 1970).

Janickina pigmentifera (Grassi 1879). Parasitic, in testis of marine arrow worms (*Chaetognatha*). Reported from Mediterranean Sea and Atlantic Ocean (Janicki 1912).

Janickina chaetognathi (Janicki 1912). Parasitic in testis of marine arrow worms (*Chaetognatha*). Reported from Mediterranean Sea and Atlantic Ocean (Janicki 1912).

FAMILY VAHLKAMPFIIDAE Jollos 1919

Vahlkampfia baltica Schmöller 1961. Bactivorous, reported from shallow coastal waters, Europe (Schmöller 1961).

Vahlkampfia salina (Hamburger 1905). Bactivorous, in shallow coastal waters, tidal pools. Known from Mediterranean and Atlantic waters, Europe and United States (Virginia), probably widely distributed (Hamburger 1905).

Vahlkampfia longicauda Schmöller 1964. Bactivorous, known from shallow Atlantic coastal waters, bays, Europe and United States (Virginia, possibly Massachusetts). Reference, Schmöller (1964).

Heteramoeba clara Droop 1962. Herbivorous, on algae and bacteria, in shallow coastal waters. Reported from northern Atlantic waters, Europe; possibly widely distributed (Droop 1962).

FAMILY PARAMOEBIDAE Poche 1913

Paramoeba eilhardi Schaudinn 1895. Herbivorous on diatoms, in marine waters, crawling on substrate or floating. Known from Atlantic coastal waters, Europe, and United States; probably worldwide. References, Schaudinn (1896), Grell (1961), Sprague et al. (1969).

Stereomyxa ramosa

Size: Contracted 250 to 300μm wide; locomotive, ramose, body mass 50 to 100μm across, with pseudopods up to 1,0 μm long. **Pseudopods**: Clear, tapered, branched, sometimes fused, up to 150μm long, 10 to 12μm at bases, end branch 10 to 50μm long, 1 to 4μm at bases, tips rounded to pointed. **Uroid**: None. **Ectoplasm**: Thin, clear, with attach debris. **Endoplasm**: Clear, vesicular and granular. **Nucleus**: Spherical, 12μm diameter, with central endosome, 4 diameter, sometimes binucleate. **Vesicles**: Many, small, 2 to 8μm diameter; no water-expulsive vesicle. **Cryst** None; but many granules. **Cyst**: Unknown. **Feeding**: Not described. **Habitat**: Marine; on coral reefs. **Distributi** Reported from reefs on Madagascar. **References**: Morphology; description; Grell (1966).

46 (*1*) Large, multinucleate with compact network-like plasmodial form; or minute, mononucleate, and forked or leaflike body form . . . . . .

47 (*46*) Very large, multinucleate; not leaflike or forked . . . . . *Corallomy*

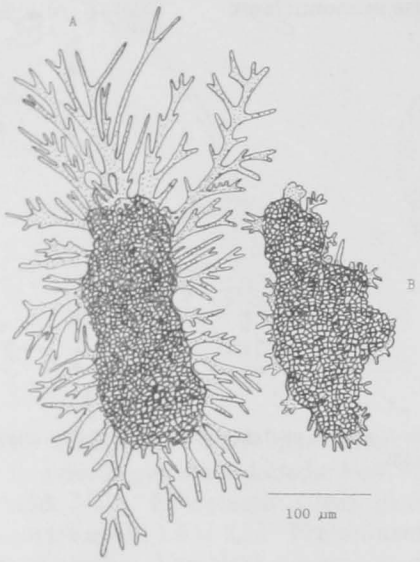


Figure 76.—*Corallomyxa mutabilis*: A—extended, feeding; B—contracted; after Grell (1966)

Corallomyxa mutabilis

Size: Contracted, irregular, 200 to 300μm across; locomotive, ramose, 2,000 to 3,000μm across, body mass more or l cruciform. **Pseudopods**: Ramose, digitate, sometimes fused, 10 to 300μm long, 5 to 20μm wide at bases, rounded tip terminal branches, 2 to 4μm. **Uroid**: None. **Ectoplasm**: Clear, gelatinous, thin, with attached diatoms and debris. **doplasm**: Clear, with vesicles and granules. **Nucleus**: Multinucleate (20 or more); each spherical, 10 to 12μm diame with central endosome, 3 to 4μm diameter. **Vesicles**: Many, small, 2 to 8μm diameter; large food vesicles; no water- pulsive vesicle. **Crystals**: None; but many granules. **Cyst**: Unknown. **Feeding**: Not described. **Habitat**: Marine; co reefs. **Distribution**: Reported from coral reefs, Madagascar. **References**: Morphology; description; Grell (1966).

47 (*46*) Minute, leaflike or forked, or stick-like; locomotion slow. Mononucleate, nucleus indistinct . . . . . *Stygamoe*

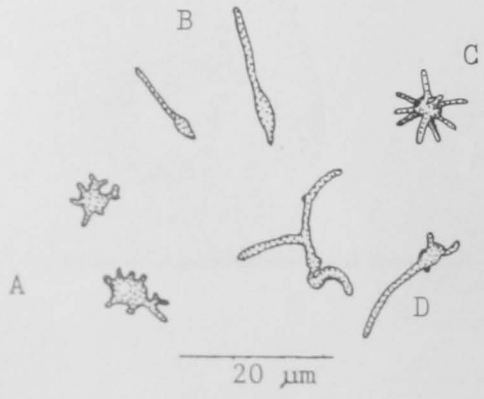


Figure 77.—*Stygamoeba polymorpha*: A, B—contracted forms; C—afloat, radiate; D— tive forms; after Sawyer (1975a).

Stygamoeba polymorpha

Size: Contracted 10 to 15μm across; radiate, body mass 8μm, with pseudopods, to 40μm across; locomotive, multiform, ramose 13 to 17μm across, or elongate to 30μm by 3 to 5μ wide. **Pseudopods**: Of contracted state, short, blunt, clear, 2 to 10μm long, 1 to 3μm wide, tips rounded; of radiate stage, 5 to 15μm long, 2 to 4μm diameter, somewhat twisted or bent; of locomotive stage, continuous with elongate body, which flows into them. **Uroid**: Absent. **Ectoplasm**: Clear, pale, glossy. **Endoplasm**: Clear, scarcely distinguishable from ectoplasm. **Nucleus**: Indistinct, round to ovoid, 1.5 to 2.0μm diameter; no endosome visible. **Vesicles**: None. **Crystals**: None. **Cyst**: Unknown. **Feeding**: Bactivorous. **Habitat**: Marine; shallow bays. **Distribution**: Known from Atlantic coast, United States, from Virginia to Massachusetts. **References**: Morphology; description; Sawyer (1975a).

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Stereomyxa ramosa Grell 1966. Known only from coral reefs, Madagascar (Grell 1966).

Corallomyxa mutabilis Grell 1966. Known only from coral reefs, Madagascar (Grell 1966).

Stygamoeba polymorpha Sawyer 1975. Reported from shallow bays, Atlantic coast, United States, from Virginia to Massachusetts (Sawyer 1975a).

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ordinating Editor: Melbourne R. Carriker, College of Marine Studies, University of Delaware, Lewes, DE 19958.

itorial Advisers: Marie B. Abbott, Marine Biological Laboratory, Woods Hole, Mass.

Arthur G. Humes, Boston University Marine Program, Marine Biological Laboratory, Woods Hole, Mass.

Wesley N. Tiffney, Department of Biology, Boston University, Boston, Mass.

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Roland L. Wigley, National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, Mass.

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The Board, which established the format for the "Marine Flora and Fauna of the Northeastern United States," invites systematists to collaborate in the preparation of manuals, reviews manuscripts, and advises the Scientific Editor of the National Marine Fisheries Service.

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COORDINATING EDITOR'S COMMENTS

Publication of the "Marine Flora and Fauna of the Northeastern United States" is most timely in view of the growing universal emphasis on environmental work and the urgent need for more precise and complete identification of coastal organisms than has been available. It is mandatory, wherever possible, that organisms be identified accurately to species. Accurate scientific names unlock the great quantities of biological information stored in libraries, obviate duplication of research already done, and often make possible prediction of attributes of organisms that have been inadequately studied.

Eugene C. Bovee began his studies on amoebae as a graduate student at the State University of Iowa in 1947 and continued them during a doctoral degree program at the University of California at Los Angeles, 1948-50. He has continued his research on systematics of amoebae and amoeboid movements on both east and west coasts of the United States and at inland stations while holding appointments successively at the University of Northern Iowa, the California State Polytechnic University at San Luis Obispo, the North Dakota State University, the University of Houston, Texas, the University of Florida, the University of California at Los Angeles, and, currently, the University of Kansas, where he is Professor of Physiology and Cell Biology.

Thomas K. Sawyer studied biology at the American University, George Washington University, and the University of Maryland. He began government service as a parasitologist in 1953 and has held posts successively at the National Institutes of Health, the U.S.D.A., the U.S.P.H.S., the Walter Reed Army Institute of Research, the Hazelton Laboratories, and, since 1964, with the National Marine Fisheries Service, as Senior Fisheries Biologist, at Oxford, Md. In that post he began studies of marine amoebae and their roles as parasites of shellfish and in environmental biodegradation. He has studied them intensively since 1966, receiving his doctoral degree in Zoology in 1973 from the University of Maryland for his studies on the amoebae of Chincoteague Bay. Those studies identified 3 new genera and 24 new species of marine amoebae.

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